SPECIFIED GAS REPORTING REGULATION

ALBERTA ENVIRONMENT REPORT ON 2006 GREENHOUSE GAS EMISSIONS

Alberta
ENVIRONMENT

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Executive summary

Alberta's position is unique in Canada. Our economy is being fuelled by an unprecedented global demand for energy. This demand comes with a unique challenge - striking the proper balance between protecting our environment, while ensuring our economy remains strong over the long term.

Alberta has repeatedly met this challenge. We were focused on climate change in the 1990s, well before there was widespread public knowledge about the issue. In 1999, Alberta set up Climate Change Central, a unique public-private partnership that helps Albertans become more energy efficient. In 2002, we became the first in Canada to announce a climate change action plan. We followed through on that plan by requiring large industry to report their greenhouse gas emissions. The requirements under the *Specified Gas Reporting Program* apply to any industrial facility in Alberta that emits more than 100,000 tonnes of greenhouse gases a year. These facilities report their greenhouse gas emissions through a secure electronic data reporting system.

In 2007, we became the first in North America to require large industry to reduce the intensity of their greenhouse gas emissions. We also held extensive consultations with the public, stakeholders and experts to help us develop a new climate change plan that is expected to be released by the end of 2007.

Results of the Reporting Program

In 2006, there were 103 Alberta facilities that reported total greenhouse gas emissions of 115.4 megatonnes (one megatonne equals one million tonnes). There were four more facilities that reported emissions in 2006 than in 2005. Emissions from all facilities increased by six per cent from the 109.1 Mt reported for 2005. The majority of reported greenhouse gas emissions were in the form of carbon dioxide (95 per cent), while the remainder was in methane (three per cent), nitrous oxide (two per cent) and hydrofluorocarbons (less than one per cent). No Alberta facilities reported emissions of perfluorocarbons or sulphur hexafluoride.

There were 95 Alberta facilities that reported both in 2005 and 2006. Total reported emissions from these facilities increased by six per cent (from 108.5 Mt to 114.5 Mt). There were 48 facilities that reported higher emissions, 43 that reported lower and 4 that showed less than 0.5 per cent change in greenhouse gas emissions.

The largest sources of reported greenhouse gas emissions were the power plants (45 per cent), oil sands (21 per cent), gas plants (seven per cent), heavy oil (seven per cent) and chemical facilities (six per cent). Reported greenhouse gas emissions came from stationary fuel combustion (86 per cent), industrial process (nine per cent), other fugitive (two per cent), venting and flaring (two per cent), on-site transportation (one per cent) and waste and wastewater (less than one per cent) sources.

A total of 273.2 Mt of greenhouse gas emissions were reported by large industrial facilities in Canada for the 2006 reporting year. The largest provincial contributors to total reported greenhouse gas emissions in Canada were Alberta (42 per cent), Ontario (26 per cent), Saskatchewan (eight per cent), Quebec (eight per cent) and British Columbia (five per cent).

Since the *Specified Gas Reporting Program* began, reported Alberta greenhouse gas emissions have increased by 12 per cent (from 103.4 Mt in 2003 to 115.4 Mt in 2006). The number of facilities reporting has also increased (from 97 in 2003 to 103 in 2006). There were 82 facilities that reported both in 2003 and in 2006. Total greenhouse gas emissions from these facilities increased by nine per cent (from 102.8 Mt to 112.2 Mt). There were 35 facilities that reported higher emissions, 43 reporting lower and four that showed less than 0.5 per cent change.

Reported Alberta greenhouse gas emissions have increased since 2003 for the cement, coal-mining, heavy oil, oil sands, petroleum refining, pipeline and power plant sectors. Reported emissions have decreased for the gas plants sector and remained roughly the same for the chemical, fertilizer, forest products, landfill and metal manufacturing sectors.

National Greenhouse Gas Inventory

The Alberta *Specified Gas Reporting Program* and the *National Mandatory Greenhouse Gas Reporting Program* cover only industrial sources of greenhouse gases. Greenhouse gas emissions data from all sources is available from the *National Greenhouse Gas Emissions Inventory*. The largest provincial contributors to total 2005 greenhouse gas emissions in Canada (all sources) were Alberta (31 per cent), Ontario (27 per cent), Quebec (12 per cent), Saskatchewan (10 per cent) and British Columbia (nine per cent).

In 2005, Alberta greenhouse gas emissions from all sources totaled 233 Mt. The largest sources of 2005 Alberta greenhouse gas emissions were mining and oil and gas (41 per cent), electricity and heat generation (23 per cent), transportation (13 per cent), agriculture (eight per cent) and industrial process sources (five per cent).

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Abbreviations

AENV:	Alberta Environment
AB:	Alberta
BC:	British Columbia
CEMS:	Continuous Emissions Monitoring Systems
CH_4:	methane
CO_2:	carbon dioxide
CO_2e:	carbon dioxide equivalent
EDR:	Electronic Data Reporting System
EPEA:	Environmental Protection and Enhancement Act
GDP:	Gross Domestic Product
GWP:	Global Warming Potential
HFCs:	hydrofluorocarbons
IPCC:	Intergovernmental Panel on Climate Change
kt:	kilotonne
MB:	Manitoba
Mt:	megatonne
N_2O:	nitrous oxide
NB :	New Brunswick
NL :	Newfoundland & Labrador
NS :	Nova Scotia
NT :	Northwest Territories and Nunavut
ON :	Ontario
PE :	Prince Edward Island
PFCs:	perfluorocarbons
QC:	Quebec
SF_6:	sulphur hexafluoride
SK :	Saskatchewan
UNFCC :	United Nations Framework Convention on Climate Change
YK :	Yukon

1.0 Alberta taking action on climate change

1.1 Goals and policies

The Government of Alberta is committed to reducing greenhouse gas emissions. Alberta's plans are outlined in *Albertans & Climate Change: Taking Action (2002)*. The plan provides a comprehensive framework to reduce greenhouse gas emissions while maintaining a prosperous economy over the long term. Actions from the 2002 plan were completed in 2007 when Alberta became the first in North America to require large industry to reduce the intensity of their greenhouse gas emissions. Alberta has completed consultations to update the 2002 plan. The updated plan is expected to be released by the end of 2007 and will include strategies and actions to meet new emission reduction targets.

Alberta's *Climate Change Action Plan* identifies the provincial *Specified Gas Reporting Program* as an important aspect of managing climate change. The three main components of the *Specified Gas Reporting Program are*: the *Specified Gas Reporting Standard*, the *Specified Gas Reporting Regulation*, and the *Climate Change and Emissions Management Act*. Information gathered under the program is needed to assist both the province and industry in characterizing emission sources and identifying opportunities for emission reductions. The program provides an annual inventory of greenhouse gas emissions from large industrial facilities in the province. It also assists the government in monitoring the results of greenhouse gas reduction strategies.

1.2 Specified Gas Reporting Program

The Alberta *Specified Gas Reporting Program* requires that all large Alberta industrial facilities emitting more than 100,000 tonnes of greenhouse gases in carbon dioxide equivalent (CO_2-e) units per year (based on the sum of direct emissions of carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFC), perflurorocarbons (PFC) and sulphur hexafluoride (SF_6)) report their greenhouse gas emissions to Alberta Environment.

Facilities are required to submit their reports through an Electronic Data Reporting (EDR) system, which is administered by Statistics Canada. In 2005 (for 2004 emissions collection), Alberta harmonized its *Specified Gas Reporting Program* with the *National Mandatory Greenhouse Gas Reporting Program*. Alberta Environment and Environment Canada have jointly collected 2004, 2005 and 2006 greenhouse gas data from Alberta's largest industrial emitters. Alberta facilities are required to report only once through the EDR to satisfy both provincial and federal reporting requirements. Alberta facilities are required to submit separate Statements of Certification and requests for confidentiality directly to both Environment Canada and Alberta Environment via mail or courier.

1.3 Specified Gas Emitters Regulation

The new requirement for large industry to reduce their emissions intensity by 12 % is mandated under a regulation in the *Climate Change and Emissions Management Act*. The *Specified Gas Emitters Regulation* came into force on July 1, 2007 and is an important step in delivering on the *Alberta Climate Change Action Plan*.

The *Specified Gas Reporting Program* and the *Specified Gas Emitters Program* are two separate programs. Facilities that exceed the 100,000 tonnes CO_2e reporting threshold must satisfy the requirements of both regulations. Facilities subject to the *Specified Gas Emitters Regulation* are required to reduce their greenhouse gas emissions intensity by 12% versus an established baseline emissions intensity. Facilities have several options to meet their emissions intensity reduction targets:

- Improve facility operations and efficiency.
- Pay $15 per tonne of CO_2e into the Climate Change and Emissions Management Fund, which will be directed to projects or technology aimed at reducing greenhouse gas emissions in the province.
- Purchase emission credits generated from projects by facilities not subject to the *Specified Gas Emitters Regulation*. These credits must be from Alberta-based projects that occurred after January 1, 2002.
- Purchase emission performance credits from facilities that are subject to the *Specified Gas Emitters Regulation*. Some facilities may have reduced their emissions intensity below their target and may want to sell any extra reduction as a credit.

2.0 About this report

2.1 Objective

This report is designed to inform interested stakeholders of the 2006 results of the *Specified Gas Reporting Program* and to provide analysis of those results that are not provided elsewhere to Albertans. This report also includes analysis of national reported greenhouse gas emissions for the rest of Canada and the *National Greenhouse Gas Inventory*, which covers greenhouse gas emissions from more than just large industrial emitters. This and previous reports on greenhouse gas emissions in Alberta are available on the Alberta Environment website at:
http://www3.gov.ab.ca/env/climate/greenhouse_gas.html

2.2 Report content

This report presents the 2006 results of the *Specified Gas Reporting Program*. This report examines the data collected in submitted specified gas reports from large industrial facilities in Alberta. The 2006 Alberta data is examined by greenhouse gas, facility type and by source category. The 2006 Alberta data is also compared to the data from past years of specified gas reporting.

The 2006 Alberta data is also compared to the 2006 greenhouse gas emissions data collected under the *National Mandatory Greenhouse Gas Reporting Program*, which is a harmonized program that covers large industrial facilities for all of Canada. The 2006 Alberta data is also compared to the *2005 National Greenhouse Gas Inventory*, which includes greenhouse gas emissions from all sources in the province (not just emissions from large industrial facilities). The data collected under the *Specified Gas Reporting Program* provides an annual inventory of greenhouse gas emissions from large industrial facilities in the province. It is also used to help track progress of greenhouse gas emission reduction strategies.

2.3 About the data

This report uses data from the *Specified Gas Reporting Program* that is current as of July 17, 2007. Any changes to the Alberta or national greenhouse gas databases after this date are not reflected in this report. Rounding of emissions data has been done to present workable numbers in this report. The result of this is that the numbers presented in this report may differ slightly in sections of this report and may also differ slightly from the same data presented from other sources. This report uses greenhouse gas emissions data from three sources: the Alberta *Specified Gas Reporting Program*, the *National Mandatory Greenhouse Gas Reporting Program* and the *National Greenhouse Gas Inventory*.

The 2003, 2004, 2005 and 2006 reported Alberta greenhouse gas data was collected in accordance with the *Climate Change & Emissions Management Act*, *Specified Gas Reporting Regulation* and the associated *Specified Gas Reporting Standard*.

Reported greenhouse gas data for the rest of Canada was collected through the *National Mandatory Greenhouse Gas Reporting Program*, under the authority of the *Canadian Environmental Protection Act*, 1999 and is published on Environment Canada's website at:

http://www.ec.gc.ca/pdb/ghg/facility_e.cfm

The *2005 National Greenhouse Gas Inventory Report* was used to examine greenhouse emissions from all sources, not just industrial. The *National Inventory Report, 1990-2005 - Greenhouse Gas Sources and Sinks in Canada* is available from Environment Canada at:

http://www.ec.gc.ca/pdb/ghg/inventory_e.cfm

2.4 Data changes

The 2006 greenhouse gas data was collected using the March 2007 *Specified Gas Reporting Standard*. This document had only minor revisions from the March 2006 *Standard* used for 2005 specified gas reporting. These changes had only minimal effect on the data being collected. There have been updates to the 2003, 2004 and 2005 datasets used in this report and therefore data in this report may differ from what was published in previous Alberta Environment greenhouse gas reports.

2.5 Data quality and program enforcement

The 2006 greenhouse gas emissions data that was collected under the *Specified Gas Reporting Program* has undergone several checks by Alberta Environment, Environment Canada and Statistics Canada to ensure facilities required to report do so and to attempt to identify major errors in submitted data. As these are reported values, it is up to the reporting facilities to submit the most accurate greenhouse gas emissions data possible.

Facilities are required to retain all records, data and other information used in the preparation of a specified gas report for at least three years after the report is submitted. Facilities must also submit a statement of certification signed by a certifying official at the facility (with authority to bind the reporting company) stating that they reviewed the specified gas report, and exercised due diligence to ensure that the submitted information is true and complete and that the amounts and values being submitted are accurate, based on reasonable estimates using available data. These regulatory requirements ensure that facilities are submitting reasonably correct emissions information and that there is a paper trail in case Alberta Environment needs to verify the submitted emissions data.

Reporting to the *Specified Gas Reporting Program* is a mandatory regulatory requirement for facilities exceeding the 100 kt CO_2e reporting threshold. The *Reporting Program* is an inventory of greenhouse gas emissions in the province with a very narrow scope, in that it only includes reported emissions from roughly the 100 largest industrial emitters in the province. The current *Specified Gas Reporting Program* also includes some industrial facilities that do not exceed the reporting threshold but still choose to voluntarily report their emissions to Alberta Environment.

There are issues with comparability between reporting years and between reporting facilities and sectors due to insufficient information collected on reference materials and calculation methods. The *Specified Gas Reporting Program* has no requirement for facilities to use consistent methods across different reporting years, no requirement for similar facilities to use the same calculation methods and no requirement for a provincial or national auditing program. Based on these facts, it is difficult to assess the quality of the reporting program.

Facilities that fail to meet the regulatory requirements of the *Specified Gas Reporting Program* could face enforcement action. Additional information on enforcement can be found by consulting the *Specified Gas Reporting Regulation*, *Administrative Penalty Regulation* and the *Climate Change and Emissions Management Act*.

3.0 Data confidentiality and access

3.1 Confidentiality process

The *Specified Gas Reporting Regulation* sets out confidentiality provisions for data collected under the *Regulation*. Section 5 of the *Regulation* permits facilities subject to the *Regulation* to request confidentiality for some or all of the information in their specified gas report. This section of the *Regulation* states that confidentiality may be requested and granted for up to 5 years on the basis that the information is commercial, financial, scientific or technical information that would reveal proprietary business, competitive or trade secret information about a specific facility, technology or corporate initiative.

The Director considers several factors when assessing a confidentiality request, including:

- Whether disclosure could reasonably be expected to significantly harm the competitive position of the specified gas reporter;
- Whether disclosure could reasonably be expected to interfere significantly with the negotiating position of the specified gas reporter;
- Whether disclosure could reasonably be expected to result in undue financial loss or gain to any person or organization;
- The availability of the information from other public sources;
- Whether there are any other competing interests that would suggest disclosure of the information is warranted.

The designated Director under the *Regulation* is the Director of the Monitoring and Evaluation Branch of Alberta Environment. The Director has 90 days to reach a decision, and can grant a portion or the entire request by deeming the information to be held as confidential for up to five years. Decisions on the 2006 confidentiality requests were made by August 29, 2007 and letters were sent to the designated certifying official of the requesting facility to inform them of the decision.

Under section 8 of the *Regulation*, the designated Director must submit a report on confidentiality requests to the Information and Privacy Commissioner. In accordance with the *Regulation*, the report must contain: the number of confidentiality requests received, number of confidentiality requests approved and the period of time prescribed for each approved request. Figure 1 summarizes the confidentiality process under the *Specified Gas Reporting Program*.

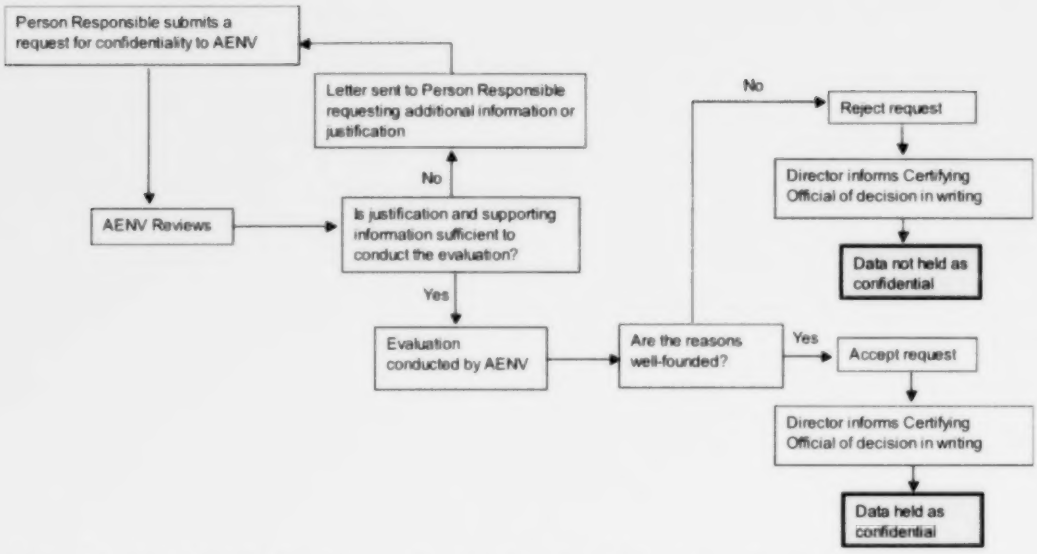
Person Responsible submits a request for confidentiality to AENV
Letter sent to Person Responsible requesting additional information or justification
No
AENV Reviews
Is justification and supporting information sufficient to conduct the evaluation?
Yes
Evaluation conducted by AENV
Are the reasons well-founded?
No
Reject request
Director informs Certifying Official of decision in writing
Data not held as confidential
Yes
Accept request
Director informs Certifying Official of decision in writing
Data held as confidential

Figure 1: Confidentiality process for the *Specified Gas Reporting Program.*

3.2 2006 confidentiality requests and decisions

There were six Alberta facilities that submitted a confidentiality request to Alberta Environment for 2006 specified gas reporting. This is the least number of facilities requesting confidentiality since the *Specified Gas Reporting Program* began. All six facilities requested that section III (A) of their specified gas report be kept confidential. Section III (A) of the 2006 specified gas report contains detailed greenhouse gas emissions by source category. The Director granted confidentiality for all six of the requests. Table 1 shows the facilities that requested confidentiality for 2006 and the decision reached by the Director for each of these requests.

Table 1: 2006 Confidentiality Decisions.

Company Name	Facility Name	Decision:
Imperial Oil	Cold Lake	Section III (A) deemed confidential for 5 years.
Petro-Canada	Edmonton Refinery	Section III (A) deemed confidential for 5 years.
Graymont	Exshaw	Section III (A) deemed confidential for 5 years.
Shell Canada Limited	Scotford Upgrader and Upgrader Cogen	Section III (A) deemed confidential for 5 years.
Shell Canada Limited	Shell Scotford Refinery	Section III (A) deemed confidential for 5 years.
Imperial Oil	Strathcona Refinery	Section III (A) deemed confidential for 5 years.

3.3 Publishing greenhouse gas data

Section 7 of the *Specified Gas Reporting Regulation* permits the Director to publish data and information in any specified gas report in any form or manner the Director considers appropriate. Alberta Environment has published an annual report on the results of the

Specified Gas Reporting Program every year since mandatory greenhouse gas reporting began. This report presents the 2006 results of the *Reporting Program*.

3.4 Requesting greenhouse gas data

In accordance with the criteria of section 6 of the *Regulation*, written requests for information contained in a submitted specified gas report that has not been deemed confidential can be directed to the designated Director. The Director shall respond to these requests within a reasonable amount of time. Figure 2 below shows the process for requesting non-confidential greenhouse gas data.

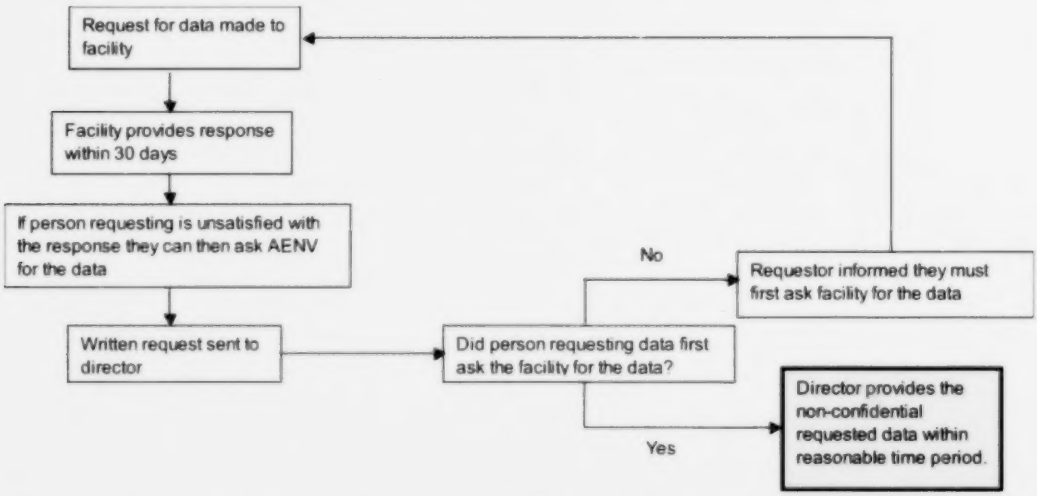
Request for data made to facility
Facility provides response within 30 days
If person requesting is unsatisfied with the response they can then ask AENV for the data
Written request sent to director
Did person requesting data first ask the facility for the data?
No
Requestor informed they must first ask facility for the data
Yes
Director provides the non-confidential requested data within reasonable time period.

Figure 2: Process for requesting non-confidential Alberta greenhouse gas data.

Note: There is currently an informal process for handling data requests, whereby a written request to the designated Director is sufficient and Alberta Environment does not require the person requesting data to first request it from the facility. To request non-confidential data collected under the *Specified Gas Reporting Program* send an email addressed to "Director, Climate Change Policy Unit" to AENV.GHG@gov.ab.ca.

4.0 2006 reported Alberta greenhouse gas emissions

4.1 Total reported greenhouse gas emissions

A total of 115.4 Mt of 2006 greenhouse gas emissions were reported by Alberta facilities through the *Specified Gas Reporting Program*. Total reported greenhouse gas emissions are the sum of carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), species of hydrofluorocarbons (HFC), species of perfluorocarbons (PFC) and sulphur hexafluoride. Before adding them together, the emissions from each greenhouse gas are converted to carbon dioxide equivalent units using global warming potentials specified in the *Specified Gas Reporting Standard*. Reported greenhouse gas emissions by facility are presented in Table 8.

2006 greenhouse gas emissions in the form of carbon dioxide made up the largest quantity (95 per cent) of what was reported with 110.4 Mt. Figure 3 shows the breakdown of total reported emissions by each greenhouse gas. Methane was the second largest quantity (three per cent) of reported 2006 greenhouse gas emissions with 3.2 Mt. 1.7 Mt or two per cent of reported emissions were in the form of nitrous oxide. Reported emissions of hydrofluorocarbons totaled 5.4 kt and represented less than one per cent of the total reported greenhouse gas emissions. There were no emissions of perfluorocarbons or sulphur hexafluoride reported for 2006.

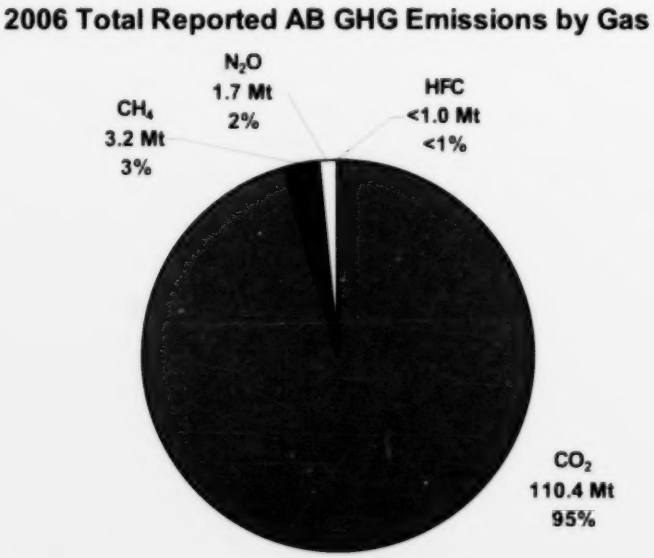

Figure 3: 2006 Total Reported AB GHG Emissions by Gas.

At total of 103 Alberta facilities reported 2006 greenhouse gas emissions to Alberta Environment through the *Specified Gas Reporting Program*. Carbon dioxide was reported by 102 of the 103 Alberta facilities. One landfill facility did not report any CO_2

emissions. 100 Alberta facilities reported emissions of methane. The facilities that reported no emissions of methane were in the cement, chemical and fertilizer sectors. There were 100 Alberta facilities that reported emissions of nitrous oxide. The three facilities that reported no emissions of nitrous oxide were in the cement, chemical and landfill sectors.

4.2 Total greenhouse gas emissions by facility type

Power plants were the largest source of 2006 reported Alberta greenhouse gas emissions with 51.7 Mt. This represented 45 per cent of 2006 total reported Alberta greenhouse gas emissions. Figure 4 shows the breakdown of total reported greenhouse gas emissions by facility type. Oil sands facilities were the second largest source (21 per cent) of reported greenhouse gas emissions with 24.0 Mt. Gas plant and heavy oil facilities each represented seven per cent of total reported emissions with 8.5 Mt and 8.2 Mt respectively. Chemical facilities were also a significant source (six per cent) of reported greenhouse gas emissions with 6.8 Mt. No other sector represented more than five per cent of 2006 total reported Alberta greenhouse gas emissions. Facilities included in the "other" category in Figure 4 together accounted for the remaining 16.2 Mt or 14 per cent of total reported emissions. Facilities included in this category were from the petroleum refining, fertilizer, pipeline, cement, lime, forest products, metal manufacturing, coal-mining and landfill sectors.

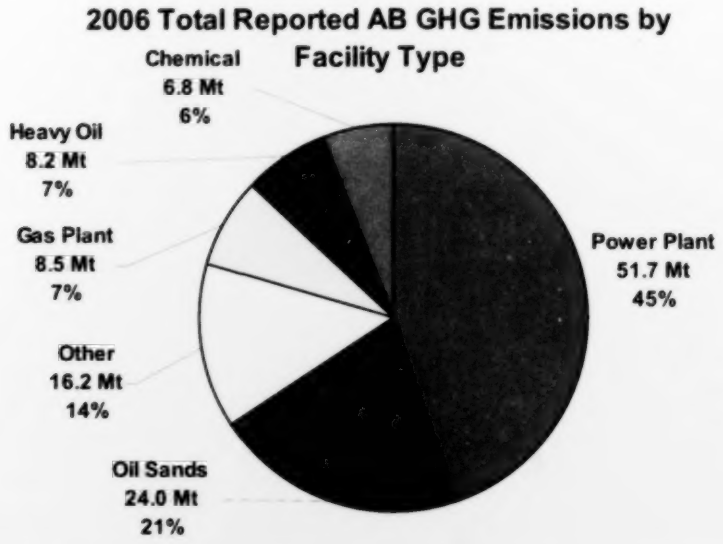

Figure 4: 2006 Total Reported AB GHG Emissions by Facility Type.

There were 103 Alberta facilities that reported 2006 greenhouse gas emissions under the *Specified Gas Reporting Program*. Table 2 shows the number of facilities reporting, average emissions and the range of emissions by sector for facilities reporting greenhouse gas emissions for 2006. The largest number (34) of reporting facilities were gas plants.

Gas plant facilities averaged greenhouse gas emissions of 250 kt and were the third largest contributing sector to total reported greenhouse gas emissions. There were 22 power plants that reported 2006 greenhouse gas emissions to Alberta Environment. These power plants averaged greenhouse gas emissions of 2,349 kt and this sector was the largest sectoral contributor to 2006 total reported Alberta greenhouse gas emissions.

There were 12 chemical facilities that reported 2006 greenhouse gas emissions. These facilities averaged 569 kt of greenhouse gas emissions and this sector was the fifth largest source of reported greenhouse gas emissions. Five oil sands facilities reported 2006 greenhouse gas emissions. These facilities averaged 4,793 kt of greenhouse gas emissions and this sector was the second largest source of greenhouse gas emissions. There were six heavy oil facilities that reported 2006 greenhouse gas emissions to Alberta Environment. These facilities averaged 1,373 kt of greenhouse gas emissions and this sector was the fourth largest source of greenhouse gas emissions.

The remaining 24 facilities were distributed among the cement, lime, coal-mining, fertilizer, forest products, landfill, metal manufacturing, petroleum refining and pipeline sectors. The average reported greenhouse gas emission (for all 103 facilities) was 1,121 kt. The ranges of reported emissions were quite large for each industrial sector and demonstrate the varying sizes and differences in operations of facilities in the same sector.

Table 2: Average Facility Emissions by Facility Type.

Facility Type	Facilities Reporting	Average Facility Emissions (kt)	Sector Emissions Range (kt)
Cement	2	1,077	930 to 1,224
Chemical	**12**	**569**	**34 to 2,758**
Coal-Mining	2	155	116 to 194
Fertilizer	**5**	**913**	**508 to 1,659**
Forest Products	4	111	89 to 150
Gas Plant	**34**	**250**	**56 to 873**
Heavy Oil	6	1,373	113 to 4,620
Landfill	**1**	**146**	**146**
Lime	1	174	174
Metal Manufacturing	**1**	**273**	**273**
Oil Sands	5	4,793	164 to 12,620
Petroleum Refining	**3**	**1,495**	**1,106 to 2,002**
Pipeline	5	730	194 to 2,332
Power Plant	**22**	**2,349**	**1 to 16,019**
All Facilities	**103**	**1,121**	**1 to 16,019**

4.3 2006 largest greenhouse gas emitters

The 103 Alberta facilities that reported greenhouse gas emissions for 2006 specified gas reporting did not equally contribute to the 115.4 Mt of emissions that were reported. Figure 5 shows the reported emissions from the largest to the smallest emitting facilities for 2006 specified gas reporting. The largest 30 emitting facilities in Alberta were

responsible for nearly 100 Mt or 87 per cent of total 2006 reported Alberta greenhouse gas emissions. The other 73 facilities that reported greenhouse gas emissions for 2006 accounted for the remaining 13 per cent or 15.5 Mt of the reported emissions. The ten largest emitting facilities in 2006 were five power plants, two oil sands facilities, two heavy oil facilities and one chemical facility. Together these ten facilities had total reported greenhouse gas emissions of 75.6 Mt, which represented 66 per cent of total 2006 reported emissions in Alberta.

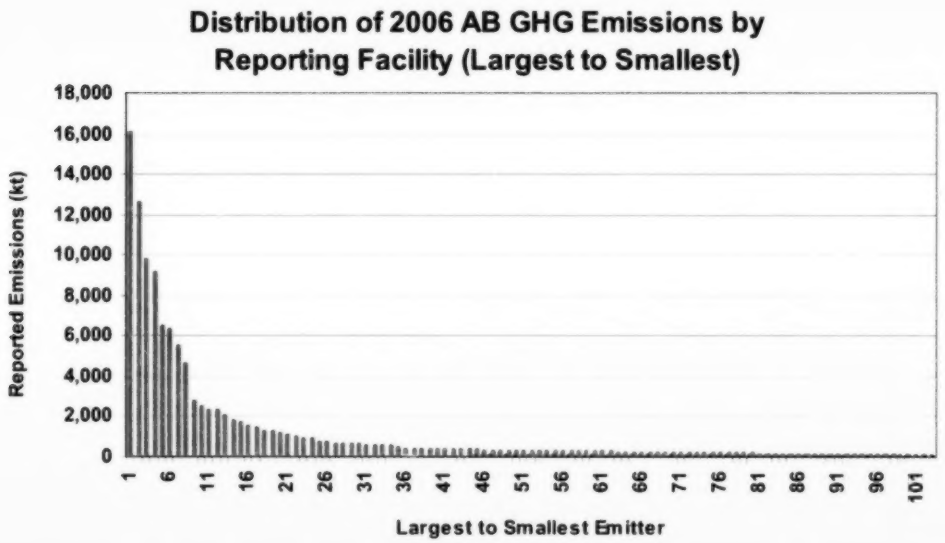

Figure 5: Distribution of 2006 AB GHG Emissions by Reporting Facility (Largest to Smallest).

4.4 Emissions by gas type

4.4.1 Carbon dioxide emissions

Power plants were the largest source of reported carbon dioxide emissions for 2006 specified gas reporting. Reported CO_2 emissions from power plants totaled 51.3 Mt or 47 per cent of all CO_2 emissions reported for 2006. Figure 6 shows the total reported CO_2 emissions by facility type. Oil sands facilities reported the second largest quantity (20 per cent) of CO_2 emissions with 22.5 Mt. Heavy oil and gas plants facilities each represented seven per cent of total reported CO_2 emissions with 8.0 Mt and 7.7 Mt respectively. Chemical facilities were also a significant source (six per cent) of reported CO_2 emissions with 6.8 Mt. No other sector represented more than five per cent of total reported CO_2 emissions. Facilities included in the "other" category in Figure 6 together accounted for the remaining 14.1 Mt or 13 per cent of total reported CO_2 emissions. Facilities included in this category were from the petroleum refining, fertilizer, pipeline, cement, lime, forest products, metal manufacturing and coal mining sectors. No CO_2 emissions were reported by the landfill sector.

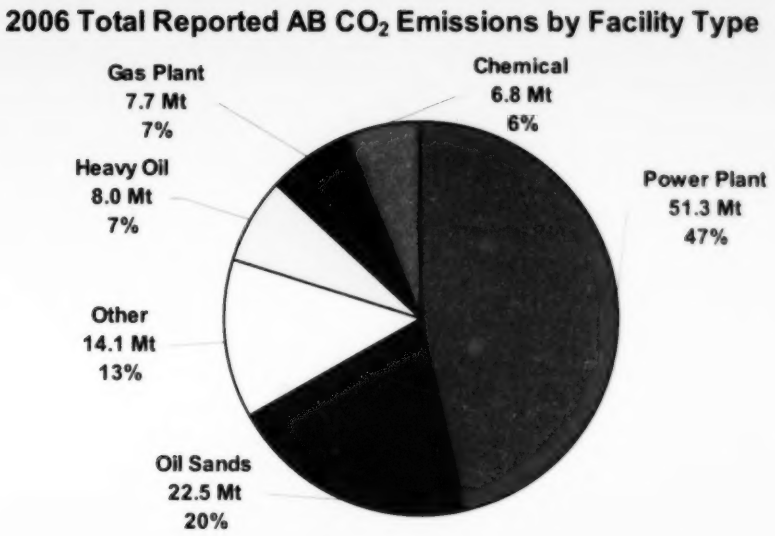

Figure 6: 2006 Total Reported AB CO_2 Emissions by Facility Type.

4.4.2 Methane emissions

Oil sands facilities were the largest source of reported methane emissions for 2006 specified gas reporting. Reported CH_4 emissions from oil sands facilities totaled 1.3 Mt or 38 per cent of all CH_4 emissions reported for 2006. Figure 7 shows the total reported CH_4 emissions by facility type. Pipeline facilities reported the second largest quantity (22 per cent) of CH_4 emissions with 0.7 Mt. Gas plant facilities were the next largest source (21 per cent) of reported CH_4 emissions with 0.7 Mt. Heavy oil and landfill facilities each represented five per cent of total reported CH_4 emissions with 0.2 Mt and 0.1 Mt respectively. No other sector represented more than five per cent of total reported CH_4 emissions. Facilities included in the "other" category in Figure 7 together accounted for the remaining 0.3 Mt or nine per cent of total reported CH_4 emissions. Facilities included in this category were from the coal-mining, petroleum refining, forest products, power plant, fertilizer, chemical, metal manufacturing, cement and lime sectors.

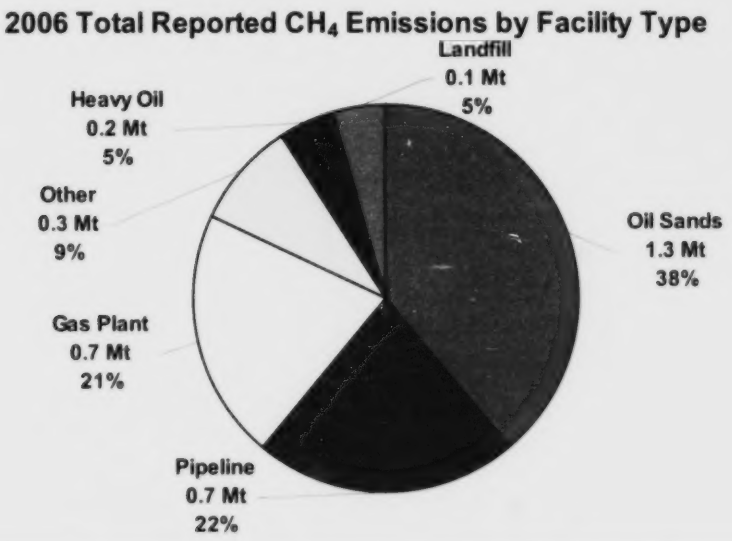

Figure 7: 2006 Total Reported AB CH_4 Emissions by Facility Type.

4.4.3 Nitrous oxide emissions

Fertilizer facilities were the largest source of reported nitrous oxide emissions for 2006 specified gas reporting. Reported N_2O emissions from fertilizer facilities totaled 0.8 Mt or 43 per cent of all N_2O emissions reported for 2006. Figure 8 shows the total reported N_2O emissions by facility type. Power plant facilities reported the second largest quantity (21 per cent) of N_2O emissions with 0.4 Mt. Oil sands facilities were the next largest source (13 per cent) of reported N_2O emissions with 0.2 Mt. Petroleum refining and gas plant facilities each represented seven per cent of total reported N_2O emissions with 0.1 Mt each. No other sector represented more than five per cent of total reported N_2O emissions. Facilities included in the "other" category in Figure 8 together accounted for the remaining 0.2 Mt or nine per cent of total reported N_2O emissions. Facilities included in this category were from the forest products, pipeline, heavy oil, chemical, coal-mining, metal manufacturing, cement and lime sectors. No N_2O emissions were reported by the landfill sector.

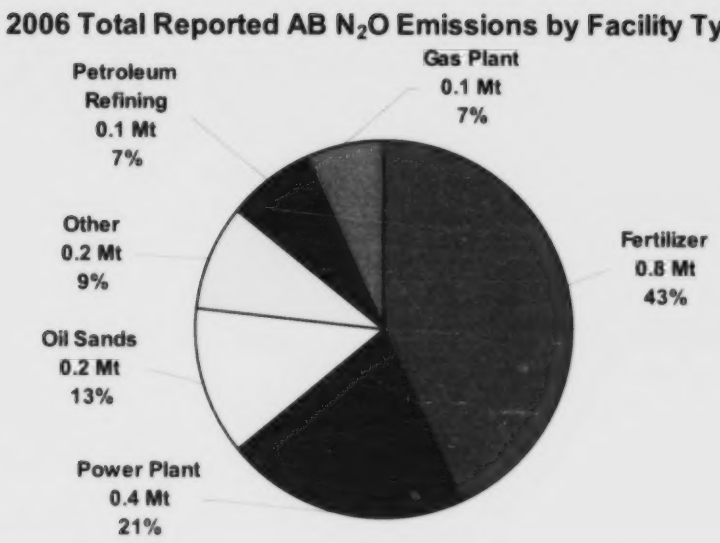
2006 Total Reported AB N_2O Emissions by Facility Type
Petroleum Refining 0.1 Mt 7%
Gas Plant 0.1 Mt 7%
Other 0.2 Mt 9%
Fertilizer 0.8 Mt 43%
Oil Sands 0.2 Mt 13%
Power Plant 0.4 Mt 21%

Figure 8: 2006 Total Reported AB N_2O Emissions by Facility Type.

4.4.4 HFC, PFC and SF_6 emissions

Two chemical facilities were the only facilities to report hydrofluorocarbon emissions for 2006 specified gas reporting. Reported HFC emissions from chemical facilities totaled 5.4 kt. There were three species of hydrofluorocarbons reported for 2006. These species were HC125, HFC134a and HFC143a. There were no Alberta facilities that reported emissions of perfluorocarbons or sulphur hexafluoride during 2006 specified gas reporting.

4.5 Reported emissions by facility type and gas type

Carbon dioxide made up the majority of reported greenhouse gas emissions for most sectors for 2006 specified gas reporting. Figure 9 shows the percentage contribution of each greenhouse gas to total reported greenhouse gas emissions per facility type. Carbon dioxide was the source of more than 90 per cent of greenhouse gas emissions for the cement, chemical, gas plant, heavy oil, lime, metal manufacturing, oil sands, petroleum refining and power plant sectors. Methane emissions were large for landfill (100 per cent), coal-mining (38 per cent), pipeline (19 per cent), forest products (11 per cent), gas plant (eight per cent) and oil sands (five per cent) facilities. Emissions of nitrous oxide were significant for fertilizer (16 per cent) and forest products (11 per cent) facilities. Emissions of hydrofluorocarbons were only reported in very small quantities by two facilities in the chemical sector.

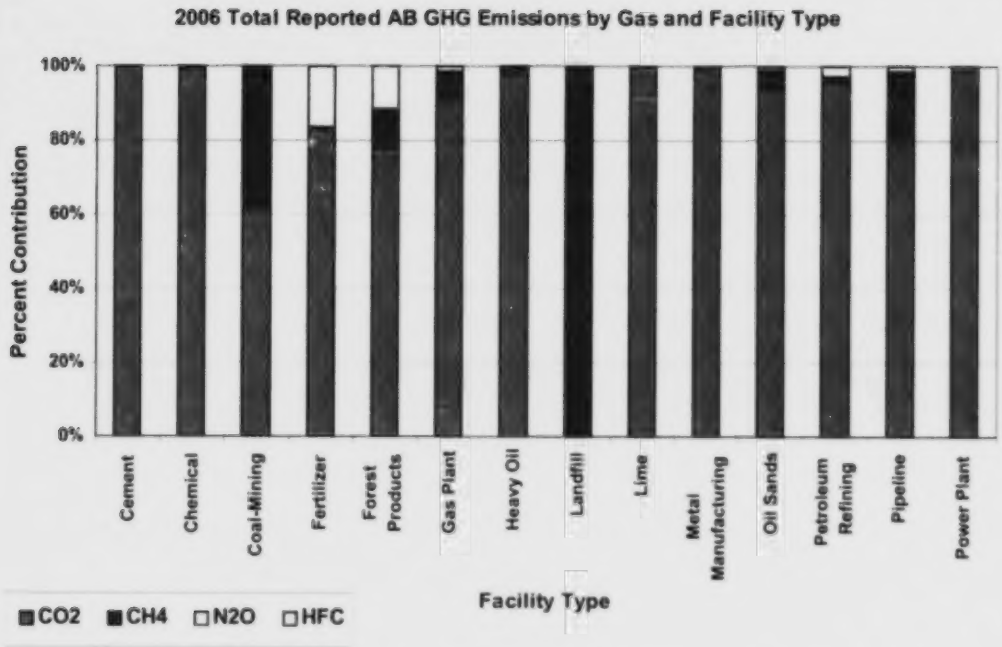

Figure 9: 2006 Total Reported AB GHG Emissions by Gas and Facility Type.

5.0 2006 reported Alberta greenhouse gas emissions by source category

The Alberta *Specified Gas Reporting Program* requires reporting of six greenhouse gases: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFC), perfluorocarbons (PFC) and sulphur hexafluoride (SF_6). Emissions of CO_2, CH_4 and N_2O must be reported according to six source categories: stationary fuel combustion, industrial process, other fugitive, venting and flaring, on-site transportation and waste and wastewater. A description of each of these source categories is found in the Glossary of this document.

Note: This section of the report uses an amalgamated petroleum/lime sector (which includes heavy oil, oil sands, petroleum refining and lime manufacturing facilities) in order to protect facility level detailed source category information that has been deemed confidential. Information on which facilities were granted confidentiality can be found in section 3.2 of this report. Source category values have also been rounded to protect confidential information.

5.1 Greenhouse gases by source category

5.1.1 Total reported greenhouse gas emissions

The largest quantity of 2006 reported Alberta greenhouse gas emissions were from stationary fuel combustion sources. Emissions from this source category totaled 98 Mt or 86 per cent of the 115.4 Mt reported by all Alberta facilities. Figure 10 presents the breakdown of 2006 total reported Alberta greenhouse gas emissions by source category. The second largest quantity (nine per cent) of reported Alberta greenhouse gas emissions came from industrial process sources, with emissions totaling 11 Mt. Other fugitive and venting and flaring sources each were responsible for two per cent of total reported Alberta emissions, with around three Mt each. On-site transportation was the source of two Mt or one per cent of total reported Alberta emissions. Waste and wastewater sources had total emissions of less than one Mt, which represented less than one per cent of total reported 2006 Alberta emissions.

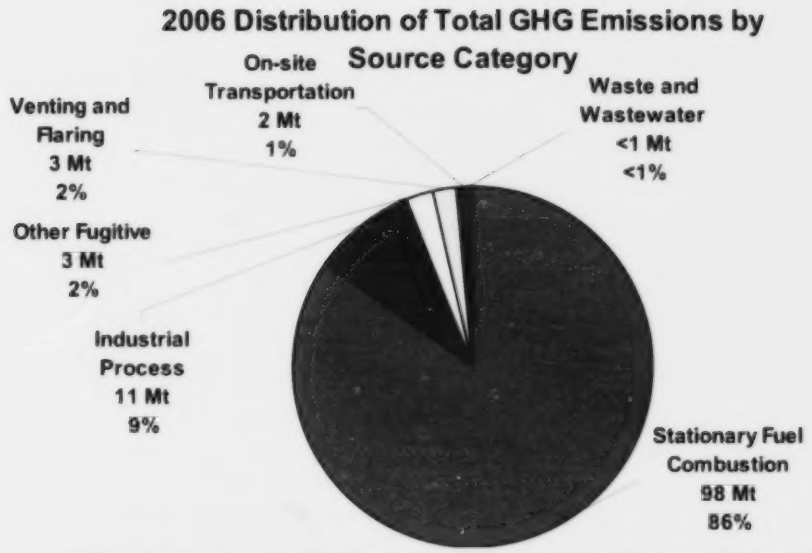
2006 Distribution of Total GHG Emissions by Source Category
On-site Transportation 2 Mt 1%
Waste and Wastewater <1 Mt <1%
Venting and Flaring 3 Mt 2%
Other Fugitive 3 Mt 2%
Industrial Process 11 Mt 9%
Stationary Fuel Combustion 98 Mt 86%

Figure 10: 2006 Distribution of Total GHG Emissions by Source Category.

5.1.2 Total reported carbon dioxide emissions

The largest quantity of 2006 reported Alberta carbon dioxide emissions were from stationary fuel combustion sources. CO_2 emissions from this source category totaled 97 Mt or 88 per cent of the 110 Mt reported by all Alberta facilities. Figure 11 presents the breakdown of 2006 total reported Alberta CO_2 emissions by source category. The second largest quantity (nine per cent) of reported Alberta CO_2 emissions came from industrial process sources, with emissions totaling 10 Mt. Venting and flaring sources were responsible for two Mt or two per cent of total reported Alberta CO_2 emissions. On-site transportation was the source of one Mt or one per cent of total reported Alberta CO_2 emissions. Other fugitive sources had total CO_2 emissions of less than one Mt, which represented less than one per cent of total reported 2006 Alberta CO_2 emissions. No CO_2 emissions were reported from waste and wastewater sources.

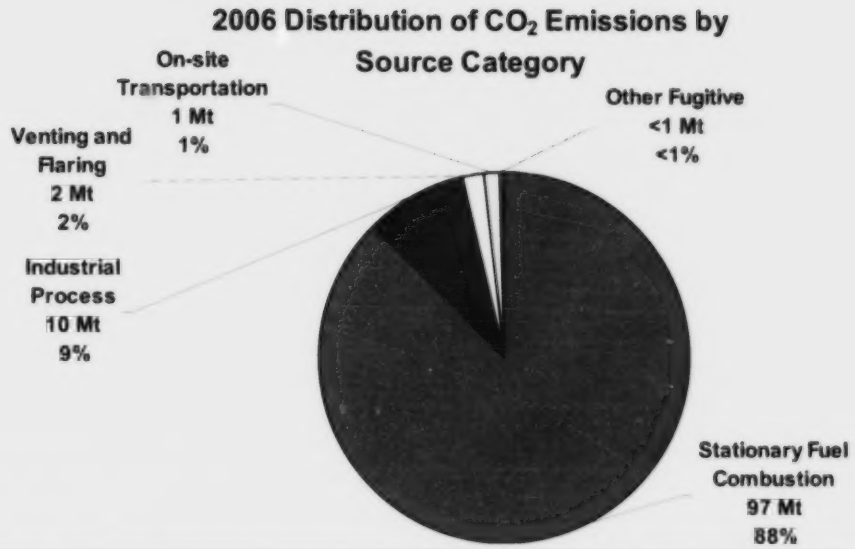
2006 Distribution of CO_2 Emissions by Source Category
On-site Transportation 1 Mt 1%
Other Fugitive <1 Mt <1%
Venting and Flaring 2 Mt 2%
Industrial Process 10 Mt 9%
Stationary Fuel Combustion 97 Mt 88%

Figure 11: 2006 Distribution of CO_2 Emissions by Source Category.

5.1.3 Total reported methane emissions

The largest quantity of 2006 reported Alberta methane emissions were from other fugitive sources. CH_4 emissions from this source category totaled nearly three Mt or 76 per cent of the three Mt reported by all Alberta facilities. Figure 12 presents the breakdown of 2006 total reported Alberta CH_4 emissions by source category. The second largest quantity (12 per cent) of reported Alberta CH_4 emissions came from stationary fuel combustion sources, with emissions totaling less than one Mt. Waste and wastewater and venting and flaring sources were each responsible for six per cent or less than one Mt of total reported Alberta CH_4 emissions. Industrial process and on-site transportation sources each had CH_4 emissions of less than one Mt, which represented less than one per cent of total reported 2006 Alberta CH_4 emissions.

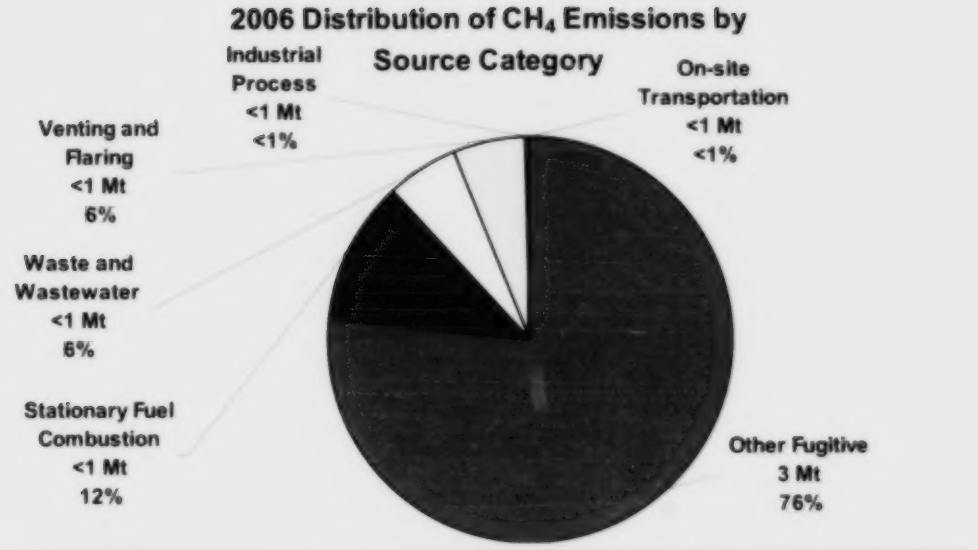
2006 Distribution of CH4 Emissions by Source Category
Industrial Process <1 Mt <1%
On-site Transportation <1 Mt <1%
Venting and Flaring <1 Mt 6%
Waste and Wastewater <1 Mt 6%
Stationary Fuel Combustion <1 Mt 12%
Other Fugitive 3 Mt 76%

Figure 12: 2006 Distribution of CH_4 Emissions by Source Category.

5.1.4 Total reported nitrous oxide emissions

The largest quantity of 2006 reported Alberta nitrous oxide emissions were from industrial process sources. N_2O emissions from this source category totaled one Mt or 44 per cent of the two Mt reported by all Alberta facilities. Figure 13 presents the breakdown of 2006 total reported Alberta N_2O emissions by source category. The second largest quantity (43 per cent) of reported Alberta N_2O emissions came from stationary fuel combustion sources, with emissions totaling one Mt. On-site transportation sources were responsible for seven per cent or less than one Mt of total reported Alberta N_2O emissions. Venting and flaring sources had N_2O emissions represented six per cent or less than one Mt of total reported 2006 Alberta N_2O emissions. Other fugitive sources totaled less than one Mt, which was less than one percent of total reported 2006 Alberta N_2O emissions. No N_2O emissions were reported from waste and wastewater sources.

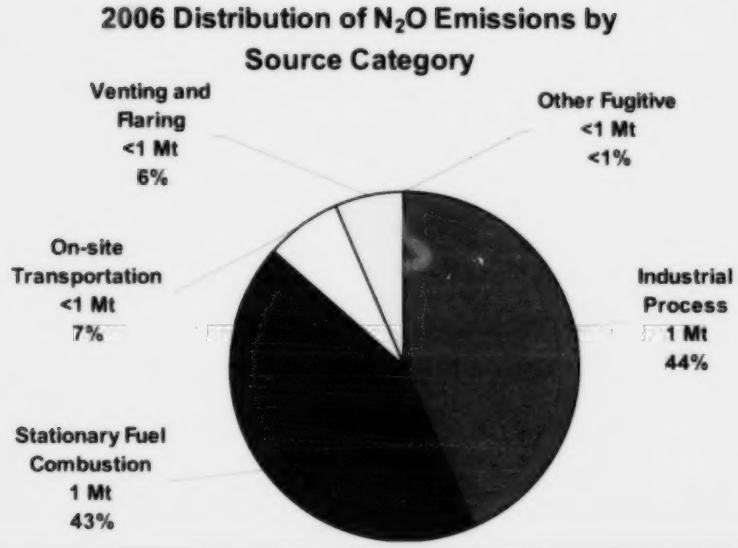
2006 Distribution of N_2O Emissions by Source Category
Venting and Flaring <1 Mt 6%
Other Fugitive <1 Mt <1%
On-site Transportation <1 Mt 7%
Industrial Process 1 Mt 44%
Stationary Fuel Combustion 1 Mt 43%

Figure 13: 2006 Distribution of N_2O Emissions by Source Category.

5.2 Source category by facility type

5.2.1 Stationary fuel combustion

The industrial sector with the largest 2006 reported Alberta greenhouse gas emissions from stationary fuel combustion sources were power plants. Greenhouse gas emissions from stationary fuel combustion sources for this sector totaled 52 Mt or 53 per cent of the 98 Mt reported by all Alberta facilities. Figure 14 presents the breakdown of 2006 total reported Alberta greenhouse gas emissions from stationary fuel combustion sources by facility type. The second largest quantity (30 per cent) of reported Alberta greenhouse gas emissions from stationary fuel combustion sources was the amalgamated petroleum/lime sector (includes heavy oil, oil sands, petroleum refining and lime manufacturing facilities), with emissions totaling 29 Mt. Chemical facilities were the source of six Mt or six per cent of total reported greenhouse gas emissions from stationary fuel combustion sources. Gas plants were the only other major sectoral contributor to reported greenhouse gas emissions from stationary fuel combustion sources with five Mt or five per cent of reported emissions from this source category. The remaining six Mt or six per cent of reported greenhouse gas emissions from stationary fuel combustion sources were from the pipeline, fertilizer, cement, forest products, metal manufacturing, coal-mining and landfill sectors.

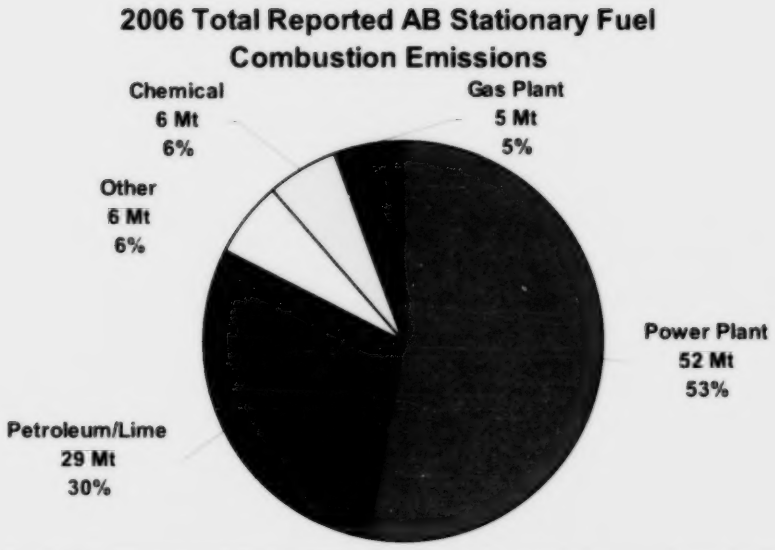

Figure 14: 2006 Total Reported AB Stationary Fuel Combustion Emissions.

5.2.2 Industrial process

The industrial sector with the largest 2006 reported Alberta greenhouse gas emissions from industrial process sources was the amalgamated petroleum/lime sector (this includes heavy oil, oil sands, petroleum refining and lime manufacturing facilities). Greenhouse gas emissions from industrial process sources for this sector totaled five Mt or 51 per cent of the 11 Mt reported by all Alberta facilities. Figure 15 presents the breakdown of 2006 total reported Alberta emissions from industrial process sources by facility type. The second largest quantity (23 per cent) of reported Alberta greenhouse gas emissions from industrial process sources were from fertilizer facilities, with greenhouse gas emissions totaling two Mt. Gas plants were the source of one Mt or 12 per cent of reported Alberta greenhouse gas emissions from industrial process sources. Chemical facilities contributed seven per cent of greenhouse gas emissions from industrial process sources, with greenhouse gas emissions totaling nearly one Mt. Cement facilities were the only other major sectoral contributor (six per cent) to industrial process emissions, with industrial process emissions of nearly one Mt. The remaining one per cent of reported Alberta greenhouse gas emissions from industrial process sources came from the metal manufacturing, coal-mining and forest products sectors. No greenhouse gas emissions from industrial process sources were reported by the landfill, pipeline or power plant sectors.

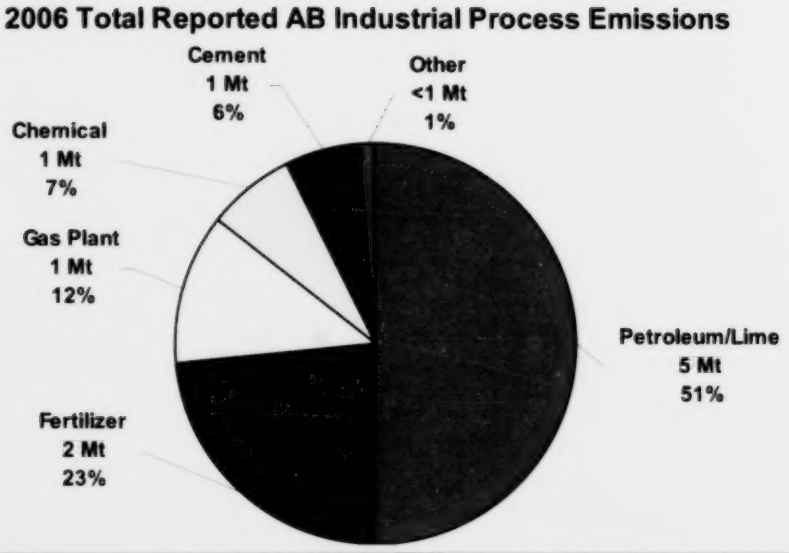

Figure 15: 2006 Total Reported AB Industrial Process Emissions.

5.2.3 Venting and flaring

The industrial sector with the largest 2006 reported Alberta greenhouse gas emissions from venting and flaring sources were gas plants. Greenhouse gas emissions from venting and flaring sources for this sector totaled one Mt or 55 per cent of the three Mt reported by all Alberta facilities. Figure 16 presents the breakdown of 2006 total reported Alberta emissions from venting and flaring sources by facility type. The second largest quantity (26 per cent) of reported Alberta greenhouse gas emissions from venting and flaring sources were from the amalgamated petroleum/lime sector (this includes heavy oil, oil sands, petroleum refining and lime manufacturing facilities), with greenhouse gas emissions totaling nearly one Mt. Chemical facilities were the source of less than one Mt or 14 per cent of reported Alberta greenhouse gas emissions from venting and flaring sources. Pipeline facilities were the next largest source (five per cent) of greenhouse gas emissions from venting and flaring sources with less than one Mt. Fertilizer facilities were responsible for the remaining quantity of reported greenhouse gas emissions from venting and flaring sources, with emissions totaling less than one Mt or less than one per cent of total reported emissions from this source category. No greenhouse gas emissions from venting and flaring sources were reported by the cement, coal-mining, forest products, landfill, metal manufacturing or power plant sectors.

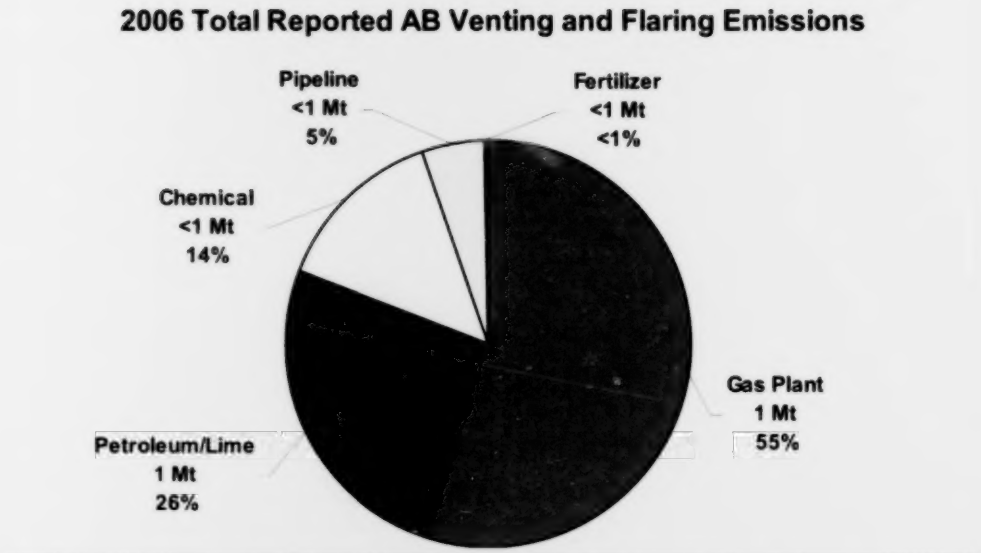

Figure 16: 2006 Total Reported AB Venting and Flaring Emissions.

5.2.4 Other fugitive

The industrial sector with the largest 2006 reported Alberta greenhouse gas emissions from other fugitive sources was the amalgamated petroleum/lime sector (this includes heavy oil, oil sands, petroleum refining and lime manufacturing facilities). Greenhouse gas emissions from other fugitive sources for this sector totaled nearly two Mt or 60 per cent of the three Mt reported by all Alberta facilities. Figure 17 presents the breakdown of 2006 total reported Alberta emissions from other fugitive sources by facility type. The second largest quantity (19 per cent) of reported Alberta greenhouse gas emissions from other fugitive sources were from the pipeline sector, with greenhouse gas emissions totaling one Mt. Gas plant facilities were the source of 16 per cent or less than one Mt of reported Alberta greenhouse gas emissions from other fugitive sources. The remaining five per cent of reported greenhouse gas emissions from other fugitive sources were from coal-mining, fertilizer, power plant and chemical facilities. No greenhouse gas emissions from other fugitive sources were reported by the cement, forest products, landfill or metal manufacturing sectors.

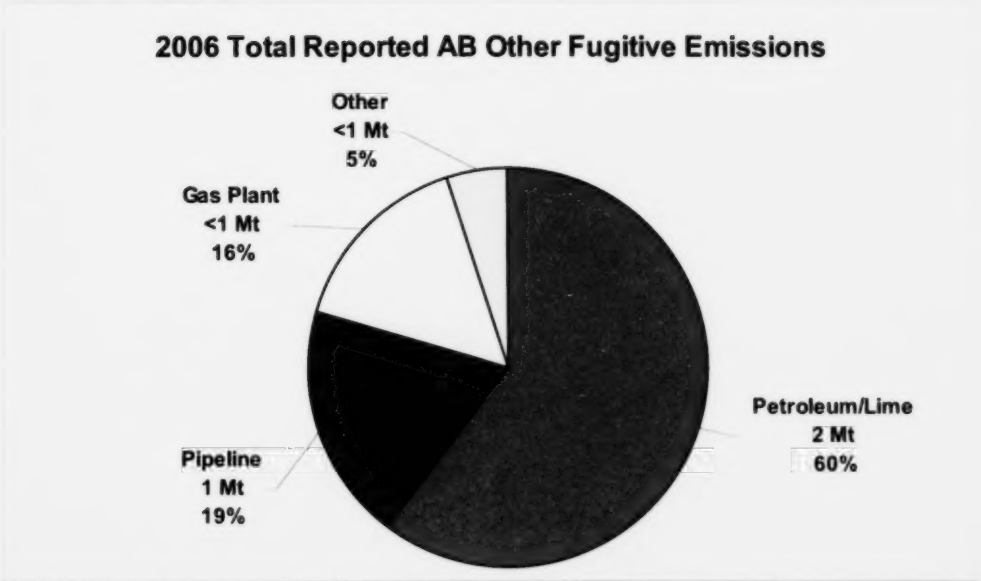

Figure 17: 2006 Total Reported AB Other Fugitive Emissions.

5.2.5 On-site transportation

The industrial sector with the largest 2006 reported Alberta greenhouse gas emissions from on-site transportation sources was the amalgamated petroleum/lime sector (this includes heavy oil, oil sands, petroleum refining and lime manufacturing facilities). Greenhouse gas emissions from other fugitive sources for this sector totaled more than one Mt or 89 per cent of the two Mt reported by all Alberta facilities. Figure 18 presents the breakdown of 2006 total reported Alberta emissions from on-site transportation sources by facility type. The only other major source of reported Alberta greenhouse gas emissions from on-site transportation sources were from the coal-mining sector, with greenhouse gas emissions represented nine per cent or less than one Mt of total reported Alberta greenhouse gas emissions from this source category. The remaining two per cent of reported greenhouse gas emissions from on-site transportation sources were from the forest products, pipeline, cement, fertilizer, power plant, chemical and metal manufacturing sectors. No greenhouse gas emissions from on-site transportation sources were reported by the gas plant or landfill sectors.

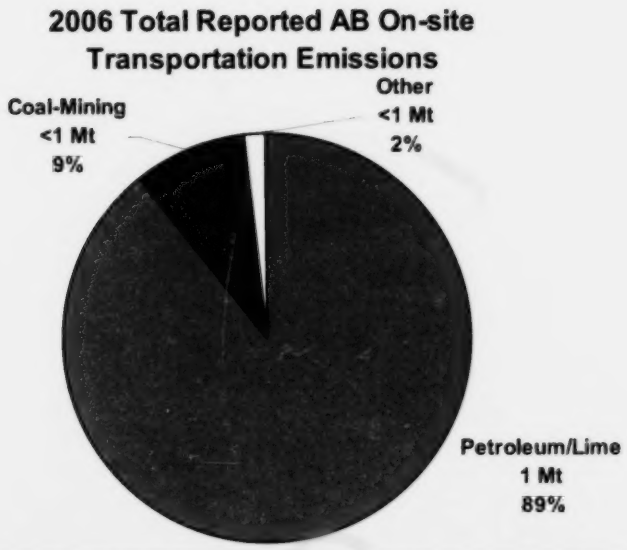

Figure 18: 2006 Total Reported AB On-site Transportation Emissions.

5.2.6 Waste and wastewater

The industrial sector with the largest 2006 reported Alberta greenhouse gas emissions from waste and wastewater sources was the landfill sector. Greenhouse gas emissions from waste and wastewater sources for this sector totaled 145 kt or 77 per cent of the 189 kt reported by all Alberta facilities. Figure 19 presents the breakdown of 2006 total reported Alberta emissions from waste and wastewater sources by facility type. The only other major source of reported Alberta greenhouse gas emissions from waste and wastewater sources were from forest products facilities, with greenhouse gas emissions totaling 43 kt or 23 per cent of total reported Alberta greenhouse gas emissions from this source category. The remaining quantity (less than one per cent) of reported greenhouse gas emissions from waste and wastewater sources were from the amalgamated petroleum/lime sector (this includes heavy oil, oil sands, petroleum refining and lime manufacturing facilities), power plant and gas plant sectors. No greenhouse gas emissions from waste and wastewater sources were reported by the cement, chemical, coal-mining, fertilizer, metal manufacturing or pipeline sectors.

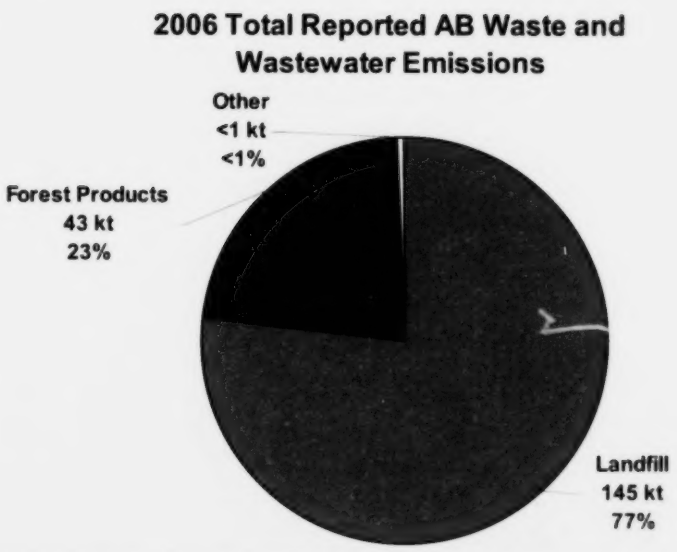

Figure 19: 2006 Total Reported AB Waste and Wastewater Emissions.

5.3 Source category by facility type and gas

Carbon dioxide from stationary fuel combustion sources was the largest source of greenhouse gas emissions for most sectors. CO_2 from industrial process sources was also large for some industrial sectors. Table 3 provides CO_2, CH_4 and N_2O emissions data by source category and facility type. Greenhouse gas emissions from the cement sector were primarily in the form of CO_2 from stationary fuel combustion (41 per cent) and industrial process (59 per cent) sources. Most of the greenhouse gas emissions from the chemical sector were in the form of CO_2 from stationary fuel combustion sources (84 per cent). Coal-mining greenhouse gas emissions were mainly CH_4 other fugitive (38 per cent) and CO_2 on-site transportation (42 per cent). Greenhouse gas emissions from the fertilizer sector were mainly in the form of CO_2 from stationary fuel combustion (45 per cent) and industrial process (38 per cent). The majority of greenhouse gas emissions from the forest products sector were in the form of CO_2 from stationary fuel combustion sources (75 per cent). Greenhouse gas emissions from gas plant facilities were mostly in form of CO_2 from stationary fuel combustion sources (59 per cent).

Greenhouse gas emissions from landfill facilities were almost entirely in the form of CH_4 from waste and wastewater sources (99 per cent). Metal manufacturing facilities showed greenhouse gas emissions split into CO_2 from stationary fuel combustion sources (74 per cent) and CO_2 from industrial process sources (25 per cent). The amalgamated petroleum/lime sector (this includes heavy oil, oil sands, petroleum refining and lime manufacturing facilities) had more than three quarters of its greenhouse gas emissions in the form of CO_2 from stationary fuel combustion sources (~80 per cent). Greenhouse gas emissions from pipeline facilities were mostly in the form of CO_2 from stationary fuel combustion sources (79 per cent). Power plant facility greenhouse gas emissions were nearly all in the form of CO_2 from stationary fuel combustion sources (99 per cent).

Table 3: 2006 Relative Sectoral Emissions of CO_2, CH_4 and N_2O by Source Category.

Facility Type	Stationary Fuel Combustion (%)			Industrial Process (%)			Venting and Flaring (%)			Other Fugitive (%)			Onsite Transportation (%)			Waste and Wastewater (%)			Total Emissions
	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	
Cement	41	0	0	59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.2 Mt
Chemical	**84**	**0**	**0**	**11**	**0**	**0**	**5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**6.8 Mt**
Coal-Mining	6	0	0	13	0	0	0	0	0	0	38	0	42	0	0	0	0	0	0.3 Mt
Fertilizer	**45**	**0**	**0**	**38**	**0**	**16**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**4.6 Mt**
Forest Products	75	1	9	1	0	2	0	0	0	0	0	0	2	0	0	0	10	0	0.4 Mt
Gas Plant	**59**	**3**	**1**	**16**	**0**	**0**	**16**	**0**	**0**	**0**	**5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**8.5 Mt**
Landfill	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	99	0	0.1 Mt
Metal Manufacturing	**74**	**0**	**0**	**25**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.3 Mt**
Petroleum / Lime	~80	<5	<5	~10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	36.9 Mt
Pipeline	**79**	**1**	**1**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**15**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3.7 Mt**
Power Plant	99	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	51.7 Mt

6.0 Other 2006 reported information

6.1 Voluntary reporting

Under the *Specified Gas Reporting Program* facilities that do not exceed the 100 kt CO_2e reporting threshold may choose to voluntarily submit a specified gas report. There were 11 Alberta facilities that voluntarily reported 2006 emissions to Alberta Environment. These facilities included two forest products facilities, four gas plants, one chemical facility and four power plants. The combined total reported greenhouse gas emissions of these 11 facilities were 0.6 Mt or 0.5 per cent of total 2006 reported greenhouse gas emissions. Total reported greenhouse gas emissions from these 11 voluntary reporters ranged from 1.4 to 99.9 kt. Alberta Environment would like to encourage industrial facilities that do not exceed the reporting threshold to voluntarily report their greenhouse gas emissions to the *Specified Gas Reporting Program.*

Alberta Environment would like to acknowledge the following companies for voluntarily submitting a specified gas report for one or more of their facilities.

Alberta-Pacific Forest Industries Inc.
Alberta Power (2000) Ltd.
ATCO Power Alberta Ltd.
BP Canada Energy Company
Canadian Natural Resources Limited
Daishowa-Marubeni International Ltd.
Dow Chemical Canada Inc.
Keyera Energy
Pengrowth Corporation

6.2 Biomass

Reporting of carbon dioxide emissions from the combustion of biomass is a mandatory reporting requirement in the *Specified Gas Reporting Program.* In accordance with national and international reporting requirements, these emissions are not included in CO_2 emissions totals or overall greenhouse gas total, although CH_4 and N_2O emissions from biomass combustion are. In order to be consistent with the *Intergovernmental Panel on Climate Change (IPCC) guidelines for national greenhouse gas inventories*, CO_2 emissions from biomass used as fuels are excluded from total CO_2 emissions. IPCC guidelines state that CO_2 emissions from biomass may not be net emissions if the biomass is sustainably produced. CO_2 emissions from biomass are therefore treated separately from CO_2 and total greenhouse gas emissions.

There were seven Alberta facilities that reported 2006 CO_2 emissions from the combustion of biomass. A total of 5.6 Mt of CO_2 emissions from biomass combustion were reported. Four of the facilities reporting CO_2 biomass combustion emissions were from the forest products sector, two were from the oil sands sector and one was from the

landfill sector. The forest products facilities were responsible for the majority of the reported CO_2 emissions from biomass combustion with 5.2 Mt or 93 per cent of reported emissions. The oil sands facilities were the source of 0.4 Mt or seven per cent of reported CO_2 emissions from biomass combustion. The landfill was the source of 0.9 kt or less than one per cent of reported CO_2 emissions from biomass combustion. Figure 20 presents the 2006 total reported Alberta CO_2 emissions from biomass combustion by facility type.

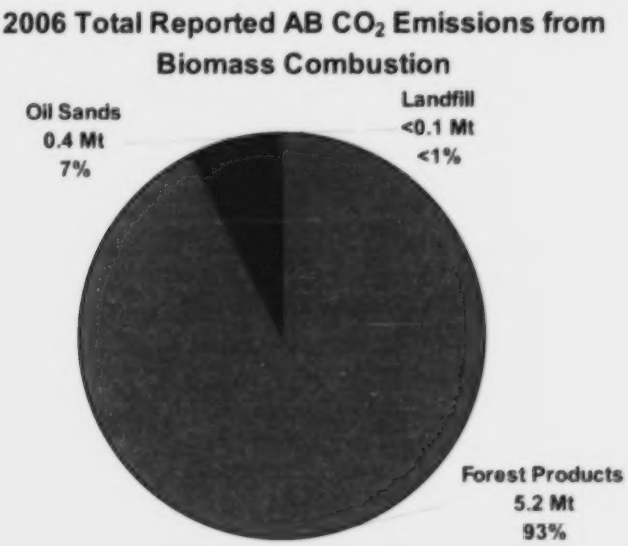

Figure 20: 2006 Total Reported AB CO_2 Emissions from Biomass Combustion.

6.3 Calculation methods

The *Specified Gas Reporting Program* requires facilities to report greenhouse gas emissions to Alberta Environment using calculation methods that are widely accepted by the industry a facility belongs to; or that are consistent with the guidelines approved for use by the *United Nations Framework Convention on Climate Change* (UNFCCC). There are four broad emission calculation methods that cover the permitted calculation methods including: monitoring or direct measurement, mass balance, emission factors and engineering estimates. These methods are described further in the Glossary of this document. Each of these methods have different degrees of accuracy and reliability. Facilities are required to include in their specified gas report which general calculation methods were used for determining their greenhouse gas emissions.

Emission factors were used by all but five of the 103 facilities reporting greenhouse gas emissions to Alberta Environment for 2006. There were 46 facilities that used engineering calculation/estimates and there were also 46 that used mass balance for determining their greenhouse gas emissions. There were 38 facilities that used

monitoring/direct measurement in their calculations. Figure 21 shows the types of emission calculation methods used for 2006 specified gas reporting in Alberta.

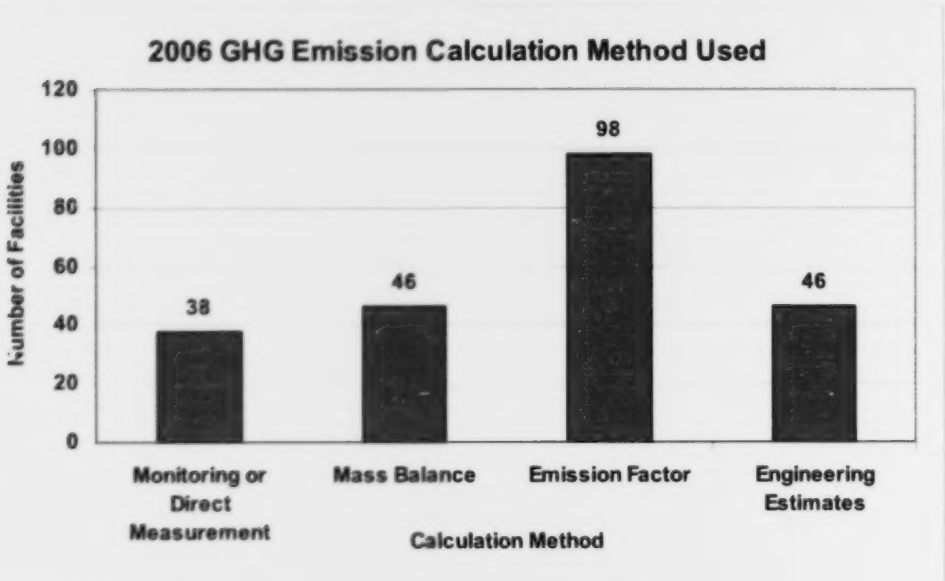

Figure 21: 2006 GHG Emission Calculation Method Used.

Rather than using one emission calculation method for all sources, facilities often use several of these calculation methods and many different methodologies and reference materials associated with each. There were 37 facilities that reported using three emission calculation methods. There were 30 and 29 facilities that reported using two and one emissions calculation methods, respectively. There were seven Alberta facilities that reported using all four emissions calculation methods. Figure 22 shows the number of emission calculation methods used for 2006 specified gas reporting.

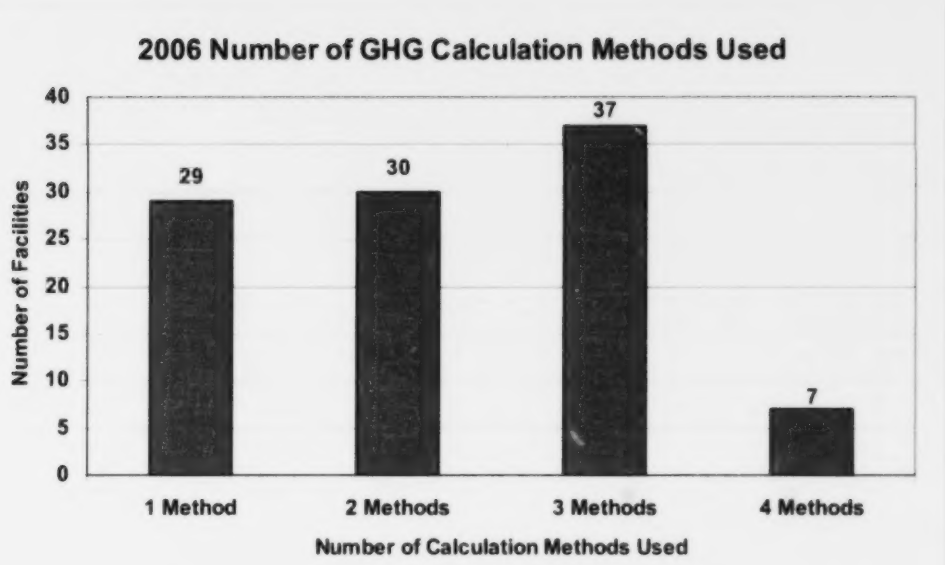

Figure 22: 2006 Number of GHG Emission Calculation Methods Used.

Facilities were not required to provide detailed information on the specific methods they used for calculating emissions of each gas from various sources. Reporting facilities were only required to list any of the four methods that were used for measuring CO_2, CH_4, N_2O, HFCs, PFCs and SF_6 from any source category. Facilities that report greenhouse gas emissions to Alberta Environment are required by section 4 of the *Specified Gas Reporting Regulation* to "retain all records, data and other information used in the preparation of a specified gas reporter for at least three years after the report is submitted". Thus, Alberta Environment does have the ability to examine the detailed calculation methods used in the reporting of greenhouse gas emissions as part of an enforcement action.

6.4 Geological injection

Reporting of geological injection of carbon dioxide is currently a voluntary requirement under the *Specified Gas Reporting Program*. Geologically injected carbon dioxide is CO_2 that is captured at a facility and then injected into a geological formation. Under the *Specified Gas Reporting Program*, geologically injected CO_2 is not considered a direct emission and is therefore not included in total CO_2 emissions or in total greenhouse gas emissions for a facility in the specified gas report. Three companies (Apache Canada Ltd, Canadian Natural Resources Limited and Keyera Energy) voluntarily reported quantities of geologically injected CO_2 for a total of three Alberta gas plants. A total of 110.5 kt of CO_2 was reported to be have been injected into geological formations in 2006 by these facilities.

6.5 Other reporting information

In addition to geological injected CO_2, section 6 of the March 2007 version of the *Specified Gas Reporting Standard* sets several other sets of additional information that facilities may voluntarily include in their specified gas report. The specified additional emissions information includes:

- The methodologies, emission factors, equations and calculations used in calculating or determining emissions;
- Citation of methodology reference publications used in calculating or determining direct emissions;
- The amount, in tonnes, of indirect emissions of CO_2, CH_4 and N_2O associated with the generation of imported/purchased electricity, steam or heat for the facility;
- A calculation of net specified gas emissions less offsets or emission reduction equivalencies;
- A determination of specified gas emission intensity expressed in tonnes, and associated calculation; and
- The amount, in tonnes, of biological sequestration of CO_2, which the specified gas reporter has assigned to the benefit of a facility's operations.

There were 48 Alberta facilities that reported additional information beyond the mandatory reporting requirements. Examples of what was reported include general explanation of emission calculation methods, facility locations, facility identification numbers, changes in methodologies from previous reporting years, treatment of certain source emissions, facility operation information, consultant contact information, indirect electricity emissions and facility ownership information.

7.0 Comparison of previously reported greenhouse gas emissions

June 2007 saw the submission of 2006 annual greenhouse gas emissions for facilities in Alberta. This was the fourth year of mandatory greenhouse gas emissions reporting for large industrial facilities in Alberta. There have been approximately 100 Alberta facilities reporting to the *Specified Gas Reporting Program* during the first four years with the 100 kt carbon dioxide equivalent reporting threshold. The facilities reporting have varied somewhat between years due to facilities falling above or below the reporting threshold. This section of the report examines the reported emissions between the different collection years of the *Specified Gas Reporting Program*.

Note: There is some question as to how comparable the reported emissions are between the reporting years, due primarily to a lack of information being collected on the calculation methods and reference materials used by facilities in determining their emissions. The present amount of information collected cannot be used to determine if a facility has calculated its emissions consistently across reporting years. The result of this is that some of the changes in the reported emissions of facilities may be the result of changes to calculation methods used instead of changes to the actual greenhouse gas emissions coming from that facility.

Another issue is that industrial sectors are not required to use the same calculation methods and reference materials for the same kinds of facilities. Two similar facilities may therefore be using different methods to calculate emissions and therefore the emissions of these facilities may not be comparable. Differences or changes may occur simply due to the different ways facilities calculated their emissions.

7.1 Comparison of 2005 and 2006 reported greenhouse gas emissions

Total reported greenhouse gas emissions from Alberta facilities increased from 109.1 to 115.4 Mt between the 2005 and 2006 reporting years. This was a 6.3 Mt or about a six per cent increase in the total reported emissions. There was an increase of four facilities reporting greenhouse gas emissions between 2005 and 2006 (from 99 to 103). Figure 23 shows the number of Alberta facilities reporting 2005 and 2006 greenhouse gas emissions by facility type. There were the same numbers of cement, fertilizer, forest products, heavy oil, lime, metal manufacturing, oil sands, petroleum refining and pipeline facilities reporting 2005 and 2006 greenhouse gas emissions. There was one additional chemical, one additional coal-mining, one additional power plant and two additional gas plants that reported 2006 greenhouse gas emissions versus 2005 reporting. There was one fewer landfill that reported 2006 greenhouse gas emissions than reported 2005 emissions. Changes in the number of facilities reporting greenhouse gas emissions can be due to facilities falling or rising above the 100 kt CO_2e reporting threshold in different years due

to shutdowns, changes in production or operations or additions of control technologies. Changes in the number of facilities reporting greenhouse gas emissions also result due to fluctuations in the number of facilities voluntarily reporting.

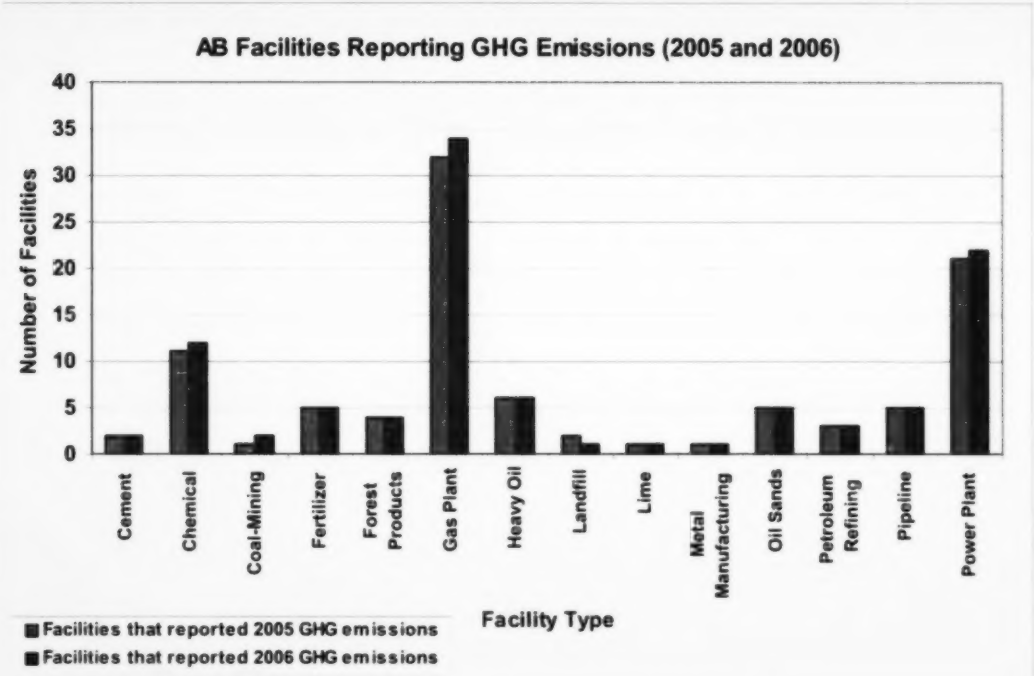

Figure 23: AB Facilities Reporting GHG Emissions (2005 and 2006).

There were 95 Alberta facilities that reported both 2005 and 2006 greenhouse gas emissions. The net change in emissions for these 95 facilities was an increase of 6.0 Mt between 2005 and 2006 (from 108.5 to 114.5 Mt). There were 48 facilities that reported higher greenhouse gas emissions for 2006 then 2005 and 43 facilities that reported lower emissions for 2006. There were also four Alberta facilities that reported no changes in their emissions between 2005 and 2006 (change of less than 0.5 per cent). Greenhouse gas emissions from facilities seeing increases rose by a total of 8.0 Mt. More than 75 per cent of this increase came from two oil sands, two heavy oil, one power plant and one petroleum refining facility. Greenhouse gas emissions from facilities that reported decreases declined by a total of 2.0 Mt. More than 30 per cent of this decrease came from one chemical, one power plant and one oil sands facility.

The average change in emissions for the 95 facilities was a six per cent increase. The average absolute change for these facilities was 15 per cent. The largest single facility increase in reported emissions was 176 per cent between 2005 and 2006. The largest single facility decrease in reported emissions was 34 per cent between 2005 and 2006. There were 10 facilities that saw changes in reported emissions of 30 per cent or greater. These facilities were from the power plant, gas plant and heavy oil sectors. Table 4 shows the changes in reported greenhouse gas emissions between 2005 and 2006 for facilities that reported emissions for both years.

Table 4: Changes in Reported Emissions for 2005 and 2006 Comparable Facilities.

Facility Type	Comparable Facilities	Facilities Reporting Higher Emissions	Facilities Reporting Lower Emissions	Facilities Reporting No Change (<0.5%)
Cement	2	1	1	0
Chemical	**10**	**4**	**6**	**0**
Coal-Mining	1	1	0	0
Fertilizer	**5**	**4**	**1**	**0**
Forest Products	4	3	1	0
Gas Plant	**30**	**10**	**19**	**1**
Heavy Oil	6	5	1	0
Landfill	**1**	**0**	**1**	**0**
Lime	1	0	1	0
Metal Manufacturing	**1**	**0**	**1**	**0**
Oil Sands	5	3	2	0
Petroleum Refining	**3**	**2**	**0**	**1**
Pipeline	5	2	3	0
Power Plant	**21**	**13**	**6**	**2**
Total	**95**	**48**	**43**	**4**

7.2 Comparison of 2003 and 2006 reported greenhouse gas emissions

Total reported greenhouse gas emissions from Alberta facilities increased from 103.4 Mt to 115.4 Mt between the first year (2003) and the most recent year of specified gas reporting (2006). This was approximately a 12 Mt or about a 12 per cent increase in the total reported emissions. There was also an increase of six facilities reporting greenhouse gas emissions between 2003 and 2006 (from 97 to 103). The number of facilities reporting in each sector varied only slightly between the reporting years. Reported greenhouse gas emissions increased in the cement, coal-mining, fertilizer, heavy oil, oil sands, petroleum refining, pipelines, and power plant sectors. Reported greenhouse gas emissions decreased in the gas plant sector. Reported greenhouse gas emissions showed little change for the forest products, landfill and metal manufacturing sectors.

There were 82 Alberta facilities that reported both 2003 and 2006 greenhouse gas emissions. The net change in emissions for these 82 facilities was an increase of 9.4 Mt between 2003 and 2006 (from 102.8 to 112.2 Mt). There were 35 facilities that reported higher greenhouse gas emissions for 2006 than 2003 and 43 facilities that reported lower emissions for 2006. There were also four Alberta facilities that reported no changes in their emissions between 2003 and 2006 (change of less than 0.5 per cent). The average change in emissions for these 82 facilities was a two per cent increase. The average absolute change for these facilities was 18 per cent. The largest single facility increase in reported emissions was 80 per cent between 2003 and 2006. The largest single facility decrease in reported emissions was 52 per cent between 2003 and 2006. Table 5 shows the changes in reported greenhouse gas emissions between 2003 and 2006 for facilities that reported emissions for both years.

Table 5: Changes in Reported Emissions for 2003 and 2006 Comparable Facilities.

Facility Type	Comparable Facilities	Facilities Reporting Higher Emissions	Facilities Reporting Lower Emissions	Facilities Reporting No Change (<0.5%)
Cement	2	2	0	0
Chemical	9	2	7	0
Coal-Mining	1	1	0	0
Fertilizer	4	3	1	0
Forest Products	3	0	3	0
Gas Plant	29	8	20	1
Heavy Oil	4	3	0	1
Landfill	1	1	0	0
Lime	1	0	1	0
Metal Manufacturing	1	0	1	0
Oil Sands	5	4	1	0
Petroleum Refining	3	2	1	0
Power Plant	17	7	8	2
Pipeline	2	2	0	0
Total	82	35	43	4

7.3 Results of the Specified Gas Reporting Program

The four years of specified gas reporting in Alberta generally yielded similar results between the different reporting years. The number of facilities participating in the *Specified Gas Reporting Program* ranged from 97 to 103. It has increased every year since 2003. The number of facilities varied between reporting years due to changes in the number of facilities voluntarily reporting their emissions. The number of facilities voluntarily reporting ranged from 13 in 2003 to only 2 in 2004. The number of voluntary reporting facilities was 9 in 2005 and 11 in 2006. The number of facilities reporting under the *Specified Gas Reporting Program* has also varied due to some facilities exceeding or falling below the reporting threshold in some years. The number of facilities that exceeded the 100 kt CO_2e threshold also varied between the reporting years. There were 84 Alberta facilities with greenhouse gas emissions of more than 100 kt CO_2e in 2003 and 96 in 2004. The number of facilities exceeding the reporting threshold was 90 in 2005 and 92 in 2006. Figure 24 shows the number of Alberta facilities that exceeded the reporting threshold and the total number that reported to the *Specified Gas Reporting Program*.

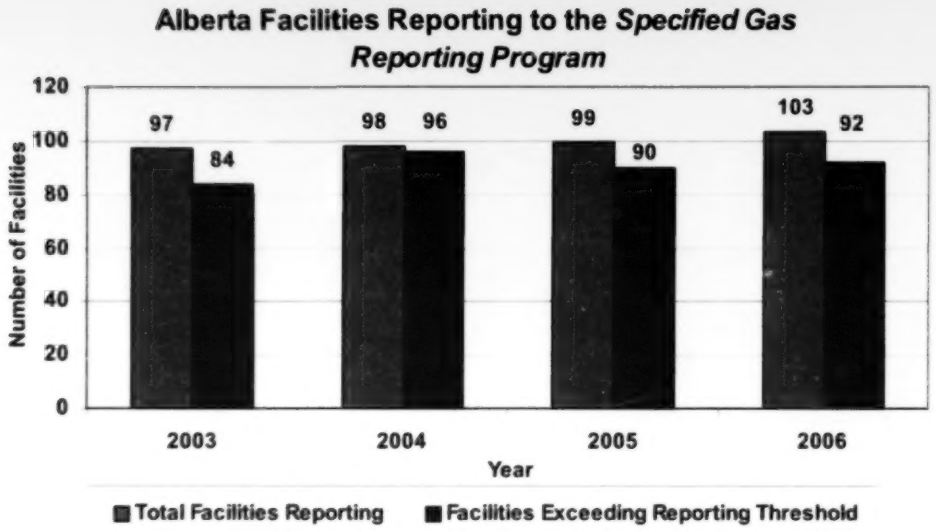

Figure 24: Alberta Facilities Reporting to the *Specified Gas Reporting Program*.

A summary of the results of the first four years of the *Specified Gas Reporting Program* is presented in Table 6. Total reported greenhouse gas emissions from Alberta facilities have ranged from 103.4 Mt to 115.4 Mt between 2003 and 2006. There were 80 Alberta facilities that reported greenhouse gas emissions under the *Reporting Program* in all four reporting years. Note that there is some question as to how comparable the reported emissions are between different reporting years due to insufficient information collected on calculation methodologies used and due to no requirement for use of the same calculation methods between years and within industrial sectors. Reported greenhouse gas emissions from these "comparable" facilities ranged from 102.3 Mt to 112.0 Mt between 2003 and 2006. Reported emissions from these facilities increased between 2003 and 2004, then decreased in 2005 and then rose again in 2006. Figure 25 presents the total reported and total comparable Alberta greenhouse gas emissions for the four years of the *Specified Gas Reporting Program*.

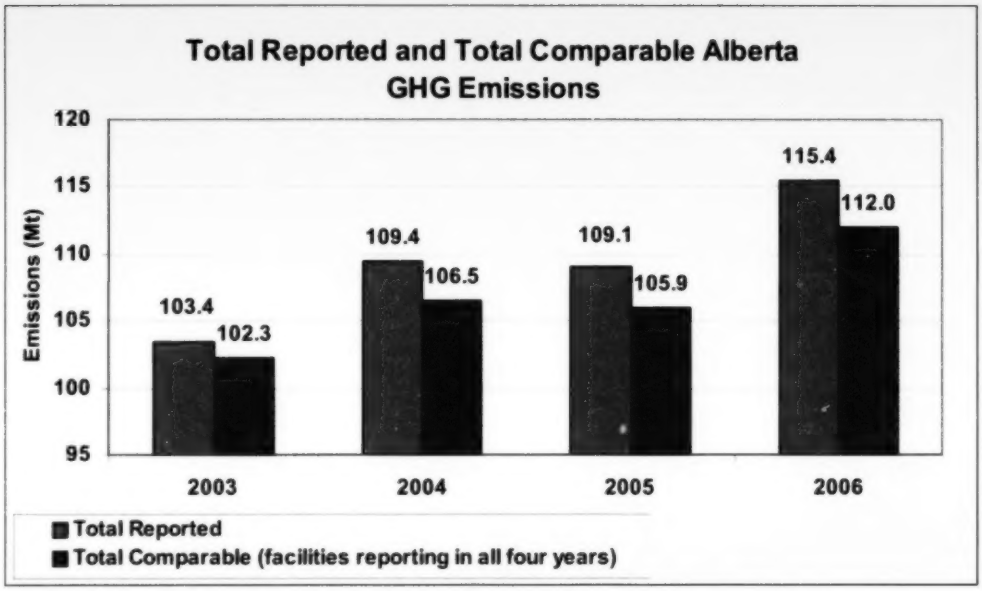

Figure 25: Total Reported and Total Comparable Alberta GHG Emissions.

Reported carbon dioxide emissions increased between 2003 and 2004, decreased in 2005 and then increased again in 2006. Reported methane emissions increased during the first three years of the *Reporting Program* and then decreased in 2006 roughly back to 2003 reported values. Reported N_2O emissions decreased between 2003 and 2004 and have since remained fairly constant. Total reported emissions from stationary fuel combustion sources increased between 2003 and 2004, decreased in 2005 and then rose again in 2006. Total reported greenhouse gas emissions from industrial process sources decreased the first three years of the *Reporting Program* and then increased in 2006. Total reported fugitive emissions remained about the same between 2003 and 2004, then rose in 2005, but decreased again in 2006. Total reported greenhouse gas emissions from other sources increased between 2003 and 2004, then decreased in both 2005 and 2006 to levels lower than in 2003.

The number of facilities reporting greenhouse gas emissions has varied within each sector for each reporting year, again due to facilities falling above or below the reporting threshold and due to facilities voluntarily reporting. Reported emissions have increased since 2003 for the cement, coal-mining, heavy oil, oil sands, petroleum refining, pipelines and power plant sectors. Reported greenhouse gas emissions decreased only for the gas plant sector. Reported emissions showed no major increases or decreases since 2003 for the chemical, fertilizer, forest products, landfills and metal manufacturing sectors.

Table 6: Results of the *Specified Gas Reporting Program.*

Category	2003	2004	2005	2006	Units
Number of Reporting Facilities	97	98	99	103	Facilities Reporting
Total Reported Emissions	**103.4**	**109.4**	**109.1**	**115.4**	**Mt**
Comparable Facilities	80	80	80	80	Facilities Reporting
Comparable Emissions	**102.3**	**106.5**	**105.9**	**112.0**	**Mt**
Number of Voluntary Facilities	13	2	9	11	Facilities Reporting
Voluntary Facility Emissions	**0.4**	**0.2**	**0.5**	**0.6**	**Mt**
Total Reported CO_2 Emissions	97.8	104.5	104.0	110.4	Mt
Total Reported CH_4 Emissions	**3.2**	**3.3**	**3.5**	**3.2**	**Mt**
Total Reported N_2O Emissions	2.8	1.6	1.6	1.7	Mt
Total Reported HFC Emissions	**N/A**	**5.2**	**7.9**	**5.4**	**kt**
Total Reported CO_2 Emissions from Biomass Combustion	2.9	4.8	5.2	5.6	Mt
Total Reported Stationary Fuel Combustion Emissions	**86.3**	**92.3**	**91.6**	**97.7**	**Mt**
Total Reported Industrial Process Emissions	12.2	11.3	10.2	10.7	Mt
Total Reported Fugitive Emissions	**3.3**	**3.2**	**5.5**	**5.4**	**Mt**
Total Reported Other Emissions	1.9	2.6	1.7	1.6	Mt
Cement	**2**	**2**	**2**	**2**	**Facilities Reporting**
Chemical	9	10	11	12	Facilities Reporting
Coal-Mining	**1**	**1**	**1**	**2**	**Facilities Reporting**
Fertilizer	5	5	5	5	Facilities Reporting
Forest Products	**3**	**4**	**4**	**4**	**Facilities Reporting**
Gas Plants	33	35	32	34	Facilities Reporting
Heavy Oil	**4**	**6**	**6**	**6**	**Facilities Reporting**
Landfills	1	1	2	1	Facilities Reporting
Lime	**1**	**1**	**1**	**1**	**Facilities Reporting**
Metal Manufacturing	1	1	1	1	Facilities Reporting
Oil Sands	**5**	**5**	**5**	**5**	**Facilities Reporting**
Petroleum Refining	3	3	3	3	Facilities Reporting
Pipelines	**12**	**5**	**5**	**5**	**Facilities Reporting**
Power Plants	17	19	21	22	Facilities Reporting
Cement	**1.6**	**1.9**	**2.1**	**2.2**	**Mt**
Chemical	6.8	7.0	7.1	6.8	Mt
Coal-Mining	**0.2**	**0.2**	**0.2**	**0.3**	**Mt**
Fertilizer	4.6	4.7	4.3	4.6	Mt
Forest Products	**0.4**	**0.5**	**0.5**	**0.4**	**Mt**
Gas Plants	9.1	9.2	8.6	8.5	Mt
Heavy Oil	**6.5**	**7.0**	**7.0**	**8.2**	**Mt**
Landfills	0.1	0.1	0.4	0.1	Mt
Lime	**CONFIDENTIAL**	**CONFIDENTIAL**	**CONFIDENTIAL**	**0.2**	**Mt**
Metal Manufacturing	0.3	0.3	0.3	0.3	Mt
Oil Sands	**19.5**	**21.5**	**20.4**	**24.0**	**Mt**
Petroleum Refining	3.9	4.0	3.8	4.5	Mt
Pipelines	**2.5**	**3.5**	**3.7**	**3.7**	**Mt**
Power Plants	47.6	49.4	50.6	51.7	Mt

8.0 2006 national reported greenhouse gas emissions

Environment Canada collects greenhouse gas emissions data from large industrial facilities with annual emissions of 100 kt CO_2e or more through the *National Mandatory Greenhouse Gas Reporting Program*. In 2005 (for 2004 emissions collection), Alberta Environment harmonized the *Specified Gas Reporting Program* with the federal *National Mandatory Greenhouse Gas Reporting Program*. This section of the report examines the 2006 greenhouse gas emissions data collected through the harmonized one-window Electronic Data Reporting System (including Alberta data).

8.1 2006 reported greenhouse gas emissions by province

A total of 273.2 Mt of greenhouse gas emissions were reported by large industrial facilities in Canada for the 2006 reporting period. The distribution of these reported emissions among the provinces and territories is presented in Figure 26. Facilities located in Alberta were the source of the largest portion of total reported greenhouse gas emissions with 115.4 Mt or 42 per cent of Canadian emissions. Facilities in Ontario were the next largest source (26 per cent) of total reported Canadian greenhouse gas emissions with 71.7 Mt. Facilities in Saskatchewan and Quebec were each the source of eight per cent of total reported Canadian greenhouse gas emissions with 22.5 Mt and 22.3 Mt respectively. Facilities in British Columbia were the source of 12.3 Mt or five per cent of total reported Canadian greenhouse gas emissions. No other province or territory was the source of more than five per cent of total reported Canadian greenhouse gas emissions. The remaining provinces and territories together contributed to 28.9 Mt or 11 per cent of total reported Canadian greenhouse gas emissions. The "other" category in Figure 26 includes New Brunswick, Nova Scotia, Newfoundland and Labrador, Manitoba, Northwest Territories and Nunavut and Prince Edward Island.

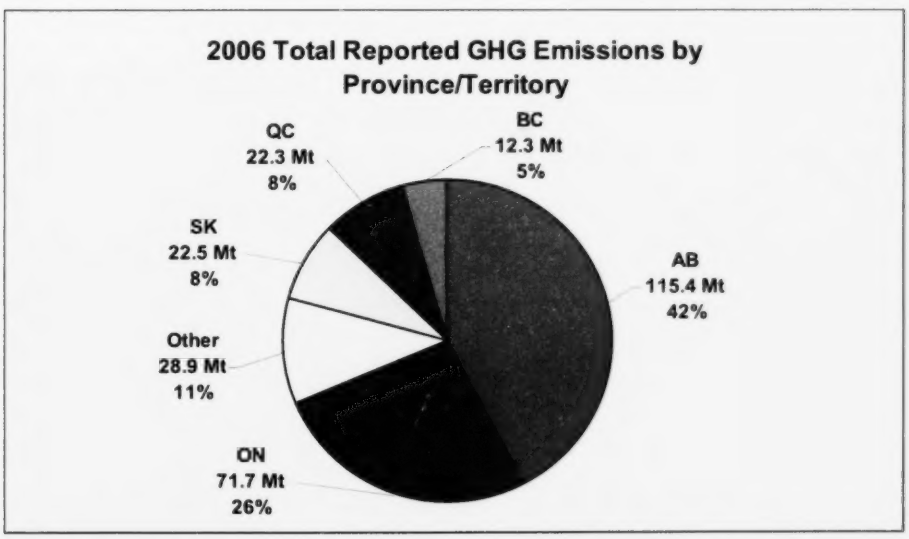

Figure 26: 2006 Total Reported GHG Emissions by Province/Territory.

8.2 2006 reported carbon dioxide emissions by province

A total of 256.3 Mt of carbon dioxide emissions were reported by large industrial facilities in Canada for the 2006 reporting period. The distribution of these reported emissions among the provinces and territories is presented in Figure 27. Facilities located in Alberta were the source of the largest portion of total CO_2 emissions with 110.4 Mt or 43 per cent of Canadian emissions. Facilities in Ontario were the next largest source (26 per cent) of total reported Canadian CO_2 emissions with 66.1 Mt. Facilities in Saskatchewan and Quebec were each the source of eight per cent of total reported Canadian CO_2 emissions with emissions of 21.6 Mt and 19.6 Mt respectively. No other province or territory was the source of more than five per cent of total reported Canadian CO_2 emissions. The remaining provinces and territories together contributed to 38.5 Mt or 15 per cent of total reported Canadian CO_2 emissions. The "other" category in Figure 27 includes British Columbia, Nova Scotia, New Brunswick, Newfoundland and Labrador, Manitoba, Northwest Territories and Nunavut and Prince Edward Island.

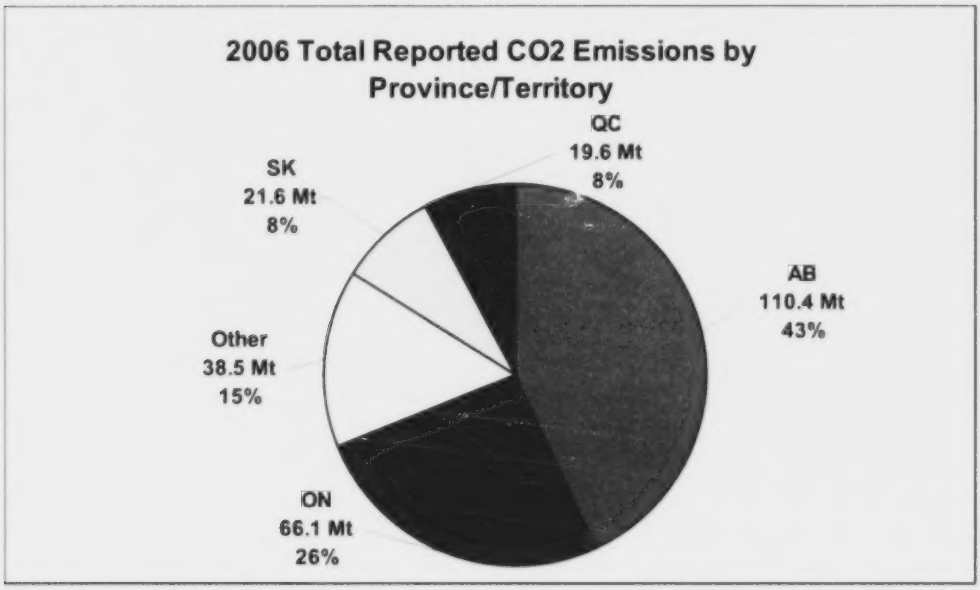

Figure 27: 2006 Total Reported CO_2 Emissions by Province/Territory.

8.3 2006 reported methane emissions by province

A total of 8.5 Mt of methane emissions were reported by large industrial facilities in Canada for the 2006 reporting period. The distribution of these reported emissions among the provinces and territories is presented in Figure 28. Facilities located in Alberta were the source of the largest portion of total CH_4 emissions with 3.2 Mt or 39 per cent of Canadian emissions. Facilities in Ontario were the next largest source (34 per cent) of total reported Canadian CH_4 emissions with 2.9 Mt. Facilities in Saskatchewan were the source of the nine per cent of reported CH_4 emissions with emissions totaling 0.8 Mt. Facilities in British Columbia were the source of eight per cent of total reported Canadian CH_4 emissions with 0.7 Mt, while facilities in Manitoba

were the source of 0.4 Mt or five per cent of total reported Canadian CH_4 emissions. No other province or territory was the source of more than five per cent of total reported Canadian CH_4 emissions. The remaining provinces and territories together contributed to 0.5 Mt or five per cent of total reported Canadian CH_4 emissions. The "other" category in Figure 28 includes Quebec, Newfoundland and Labrador, New Brunswick, Nova Scotia, Northwest Territories and Nunavut and Prince Edward Island.

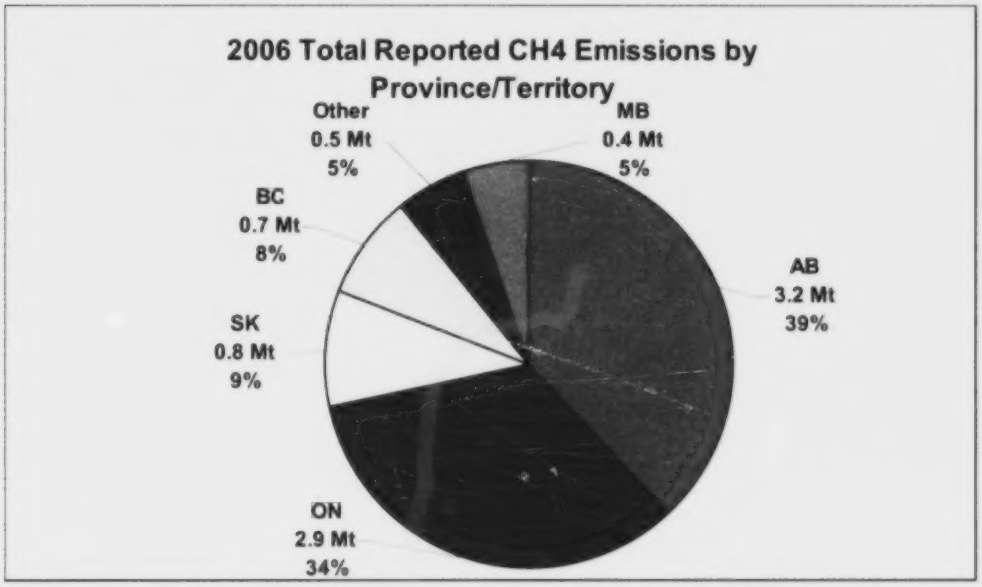

Figure 28: 2006 Total Reported CH_4 Emissions by Province/Territory.

8.4 2006 reported nitrous oxide emissions by province

A total of 4.4 Mt of nitrous oxide emissions were reported by large industrial facilities in Canada for the 2006 reporting period. The distribution of these reported emissions among the provinces and territories is presented in Figure 29. Facilities located in Alberta were the source of the largest portion of total N_2O emissions with 1.7 Mt or 39 per cent of Canadian emissions. Facilities in Ontario were the next largest source (36 per cent) of total reported Canadian N_2O emissions with 1.6 Mt. Facilities in Nova Scotia were the source of nine per cent of reported N_2O emissions with emissions totaling 0.4 Mt. Facilities in British Columbia were the source of five per cent of total reported Canadian N_2O emissions with 0.2 Mt. No other province or territory was the source of more than five per cent of total Canadian N_2O emissions. The remaining provinces and territories together contributed to 0.5 Mt or 11 per cent of total reported Canadian N_2O emissions. The "other" category in Figure 29 includes Saskatchewan, Quebec, Manitoba, New Brunswick, Newfoundland and Labrador, Northwest Territories and Nunavut and Prince Edward Island.

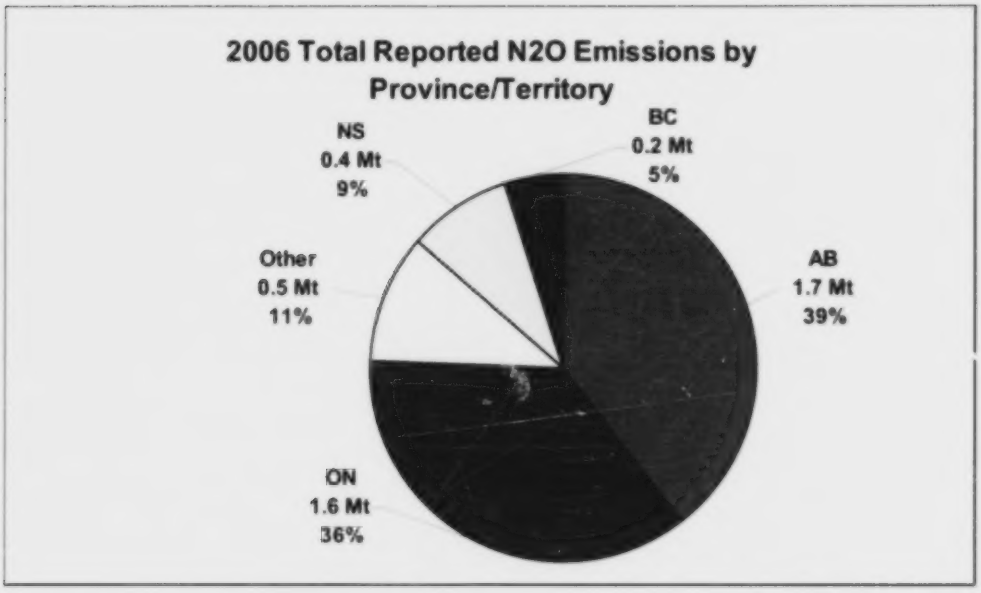

Figure 29: 2006 Total Reported N_2O Emissions by Province/Territory.

8.5 2006 reported emissions of hydrofluorocarbons by province

A total of 40.8 kt of hydrofluorocarbon emissions were reported by large industrial facilities in Canada for the 2006 reporting period. The distribution of these reported emissions among the provinces and territories is presented in Figure 30. Facilities located in Quebec were the source of the largest portion of total HFC emissions with 34.8 kt or 85 per cent of Canadian emissions. Facilities in Alberta were the next largest source (13 per cent) of total reported Canadian HFC emissions with 5.4 kt. HFC emissions were not reported by any facilities in Newfoundland and Labrador, Nova Scotia or Prince Edward Island. The remaining provinces and territories together contributed to 0.7 kt or two per cent of total reported Canadian HFC emissions. The "other" category in Figure 30 includes Ontario, Northwest Territories and Nunavut, British Columbia, Manitoba and Saskatchewan.

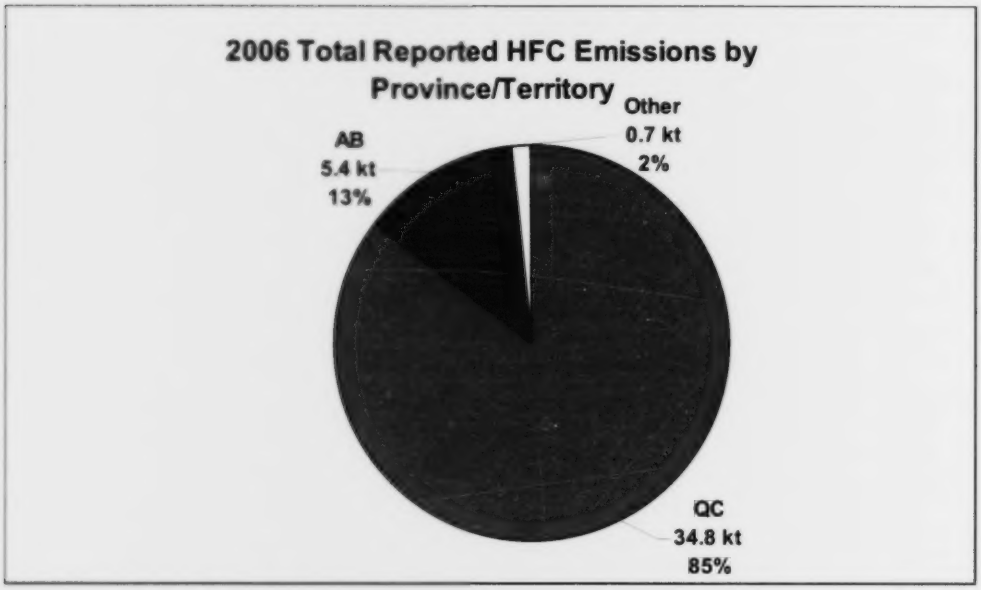

Figure 30: 2006 Total Reported HFC Emissions by Province/Territory.

8.6 2006 reported emissions of perfluorocarbons and sulphur hexafluoride

A total of 2.6 Mt of perfluorocarbons emissions were reported for 2006 greenhouse gas reporting. Facilities in Quebec were the source of 2.1 Mt or 80 per cent of the reported emissions. British Columbia was the only other province with facilities reporting PFC emissions, with emissions of PFCs totaling 0.5 Mt or 20 per cent of reported emissions. A total of 1.2 Mt of sulphur hexafluoride was reported by Canadian facilities for 2006 greenhouse gas reporting. Facilities in Ontario reported a total of 1.1 Mt or 90 per cent of the reported SF_6 emissions. Facilities in Quebec were the source of 0.1 Mt or eight per cent of reported SF_6 emissions. No other province or territory was the source of more than five per cent of total Canadian SF_6 emissions. The remaining 19 kt of SF_6 emissions were reporting by facilities in Nova Scotia, British Columbia and Manitoba.

9.0 Comparison to the *National Greenhouse Gas Inventory* (2005)

The *National Greenhouse Gas Inventory* is prepared in accordance with Canada's obligations under the *United Nations Framework Convention on Climate Change* (UNFCCC). The UNFCCC reporting guidelines include guidelines developed by the *Intergovernmental Panel on Climate Change* that set out how greenhouse gas emissions inventories are prepared and what is included in the national inventory report. In addition to industrial sources, the *National Greenhouse Gas Inventory* also includes estimates of greenhouse gas emissions from other sources including transportation, agriculture, construction, commercial, institutional and residential.

The *National Inventory Report: Greenhouse Gas Sources and Sinks in Canada 1990-2005*, which was published in May 2007, contains the most recent national greenhouse gas inventory for Canada. The *National Inventory* includes estimates of national, provincial and territorial greenhouse gas emissions. Alberta Environment uses the *National Inventory* and the emissions information collected through the *Specified Gas Reporting Program* as a basis of analysis for greenhouse gas emissions and trends for Alberta. The information is used for issue identification, policy development and evaluation of current Alberta actions on climate change.

9.1 Coverage of the Specified Gas Reporting Program

The 115.4 Mt of greenhouse gas emissions reported to Alberta Environment under the *Specified Gas Reporting Program* for 2006 accounted for nearly 50 per cent of 233 Mt of total Alberta greenhouse gas emissions in the *2005 National Greenhouse Gas Inventory*. As the *National Greenhouse Gas Inventory* includes more than just industrial sources, this coverage is not unexpected. Looking at only industrial sources of greenhouse gas emissions, the *Specified Gas Reporting Program* accounted for 69 per cent of the 168 Mt of total Alberta industrial greenhouse gas emissions. Industrial sources from the *National Inventory* include: electricity and heat generation, fossil fuel industries, mining and oil and gas extraction, manufacturing, agriculture and forestry (stationary combustion), pipelines, fugitive coal mining, fugitive oil and natural gas and industrial process.

The *Reporting Program* captured 62 per cent of carbon dioxide emissions, eight per cent of methane emissions and 15 per cent of nitrous oxide emissions. Looking at source categories, the *Reporting Program* captured 74 per cent of stationary fuel combustion sources, 88 per cent of industrial process sources, 15 per cent of fugitive sources, five per cent of transportation and seven per cent of waste sources. Table 7 summarizes the coverages of the *Specified Gas Reporting Program*.

Table 7: Source Category Coverage of the *Specified Gas Reporting Program.*

Category	2005 Inventory (Mt)	2006 Reported (Mt)	% Coverage
Total GHG Emissions	233	115	50
Total Industrial Emissions	**168**	**115**	**69**
Carbon Dioxide	179	110	62
Methane	**42**	**3**	**8**
Nitrous Oxide	12	2	15
Stationary Fuel Combustion (including pipelines)	**132**	**98**	**74**
Industrial Process	12	11	88
Fugitive	**37**	**5**	**15**
Transportation (excluding pipelines)	31	1	5
Waste	**3**	**<1**	**7**

9.2 2005 greenhouse gas emissions by province/territory

According to the *National Greenhouse Gas Inventory*, 2005 Canadian greenhouse gas emissions from all sources totaled 747 Mt. Provincial and territorial greenhouse gas emission estimates do not add up exactly to this total due to rounding and suppression of confidential data. Provincial and territorial emission totals in the *National Inventory* do not include HFCs, PFCs, CO_2 from limestone and soda ash use and emissions associated with ammonia production.

Alberta was the source of the largest portion of 2005 Canadian greenhouse gas emissions with 233 Mt or 31 per cent of total Canadian greenhouse gas emissions. Figure 31 shows the total 2005 Canadian greenhouse gas emissions by province. Ontario was the source of the second largest portion (27 per cent) of greenhouse gas emissions in Canada with 201 Mt. Quebec was the source of 89 Mt or 12 per cent of 2005 Canadian greenhouse gas emissions. Saskatchewan was the source 71 Mt or 10 per cent of Canadian GHG emissions, while British Columbia was the source of 66 Mt or nine per cent of Canadian GHG emissions. No other province or territory was the source of more than five per cent of total Canadian greenhouse gas emissions. The remaining provinces and territories together were responsible for the remaining 79 Mt or 11 per cent of 2005 Canadian greenhouse gas emissions. The "other" category in Figure 31 includes Nova Scotia, New Brunswick, Manitoba, Newfoundland and Labrador, Prince Edward Island, Northwest Territories and Nunavut and the Yukon.

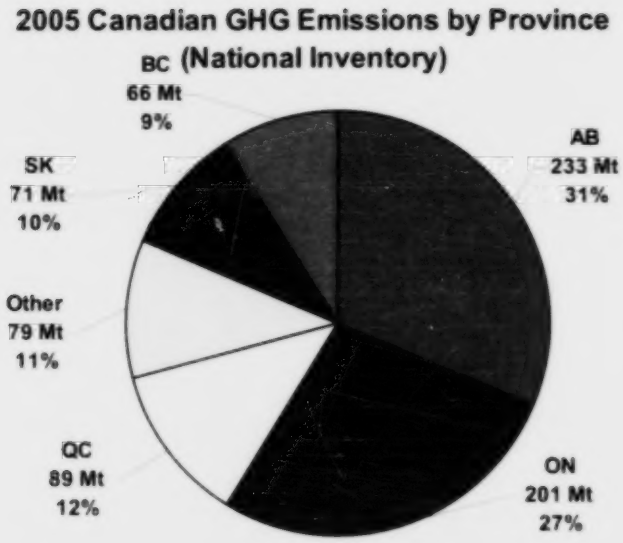

Figure 31: 2005 Canadian GHG Emissions by Province/Territory (National Inventory).

9.2.1 2005 CO_2 emissions by province/territory

According to the *National Greenhouse Gas Inventory*, 2005 Canadian CO_2 emissions from all sources totaled 583 Mt. Figure 32 shows the total 2005 Canadian CO_2 emissions by province. Alberta was the source of the largest portion of 2005 Canadian CO_2 emissions with 179 Mt or 31 per cent of total Canadian CO_2 emissions. Ontario was the source of the second largest portion (30 per cent) of CO_2 emissions in Canada with 174 Mt. Quebec was the source of 69 Mt or 12 per cent of 2005 Canadian CO_2 emissions. British Columbia was the source 53 Mt or nine per cent of Canadian CO_2 emissions, while Saskatchewan was the source of 42 Mt or seven per cent of Canadian CO_2 emissions. No other province or territory was the source of more than five per cent of total Canadian CO_2 emissions. The remaining provinces and territories together were responsible for the remaining 64 Mt or 11 per cent of 2005 Canadian CO_2 emissions. The "other" category in Figure 32 includes Nova Scotia, New Brunswick, Manitoba, Newfoundland and Labrador, Prince Edward Island, Northwest Territories and Nunavut and the Yukon.

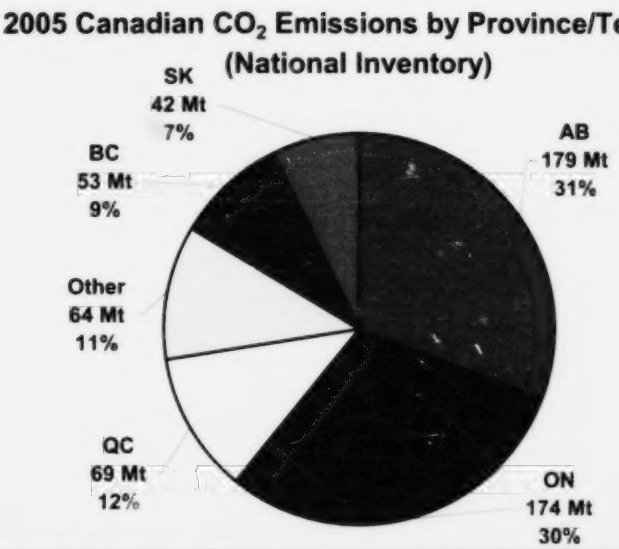

Figure 32: 2005 Canadian CO_2 Emissions by Province/Territory (National Inventory).

9.2.2 2005 CH_4 emissions by province/territory

According to the *National Greenhouse Gas Inventory*, 2005 Canadian CH_4 emissions from all sources totaled 110 Mt. Figure 33 shows the total 2005 Canadian CH_4 emissions by province. Alberta was the source of the largest portion of 2005 Canadian CH_4 emissions with 42 Mt or 39 per cent of total Canadian CH_4 emissions. Saskatchewan was the source of the second largest portion (20 per cent) of CH_4 emissions in Canada with 22 Mt. Ontario was the source of 14 Mt or 13 per cent of 2005 Canadian CH_4 emissions. Quebec was the source 12 Mt or 11 per cent of Canadian CH_4 emissions, while British Columbia was the source of 10 Mt or nine per cent of Canadian CH_4 emissions. No other province or territory was the source of more than five per cent of total Canadian CH_4 emissions. The remaining provinces and territories together were responsible for the remaining nine Mt or eight per cent of 2005 Canadian CH_4 emissions. The "other" category in Figure 33 includes Manitoba, New Brunswick, Nova Scotia, Newfoundland and Labrador, Prince Edward Island, Northwest Territories and Nunavut and the Yukon.

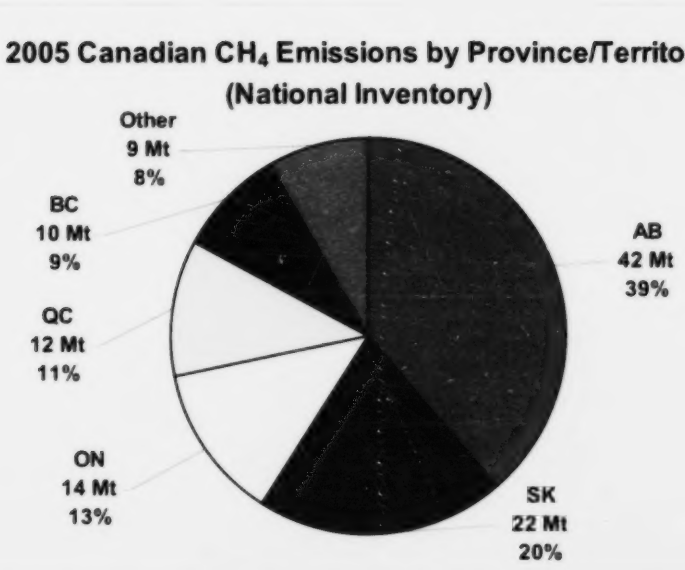

Figure 33: 2005 Canadian CH_4 Emissions by Province/Territory (National Inventory).

9.2.3 2005 N_2O emissions by province/territory

According to the *National Greenhouse Gas Inventory*, 2005 Canadian N_2O emissions from all sources totaled 44 Mt. Figure 34 shows the total 2005 Canadian N_2O emissions by province. Alberta and Ontario were the largest sources of 2005 Canadian N_2O emissions, each with 12 Mt or 27 per cent of total Canadian N_2O emissions. Saskatchewan was the source of the next largest portion (15 per cent) of N_2O emissions in Canada with seven Mt. Quebec was the source of five Mt or 12 per cent of 2005 Canadian N_2O emissions. Manitoba was the source four Mt or eight per cent of Canadian N_2O emissions, while British Columbia was the source of three Mt or six per cent of Canadian N_2O emissions. No other province or territory was the source of more than five per cent of total Canadian N_2O emissions. The remaining provinces and territories together were responsible for the remaining two Mt or five per cent of 2005 Canadian N_2O emissions. The "other" category in Figure 34 includes New Brunswick, Nova Scotia, Prince Edward Island, Newfoundland and Labrador, Northwest Territories and Nunavut and the Yukon.

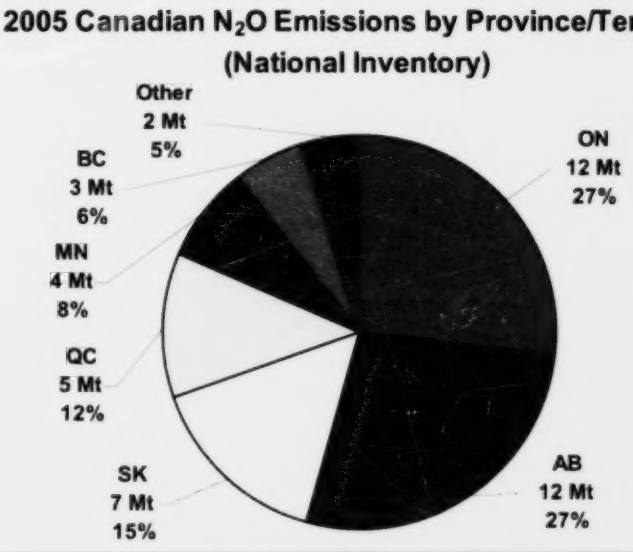

Figure 34: 2005 Canadian N_2O Emissions by Province/Territory (National Inventory).

9.3 2005 Alberta greenhouse gas emissions

A total of 233 Mt of greenhouse gases were emitted from all sources in Alberta according to the *2005 National Greenhouse Gas Inventory*. Figure 35 shows a breakdown of 2005 Alberta greenhouse gas emissions from all sources by gas. Of these emissions, 179 Mt or 77 per cent were in the form of carbon dioxide. 42 Mt or 18 per cent of total greenhouse gas emissions were in the form of methane. The remaining five per cent or 12 Mt of greenhouse gas emission in Alberta were in the form of nitrous oxide. There were no significant sources of emissions of hydrofluorocarbons, perfluorocarbons or sulphur hexafluoride in Alberta according to the *National Greenhouse Gas Inventory*.

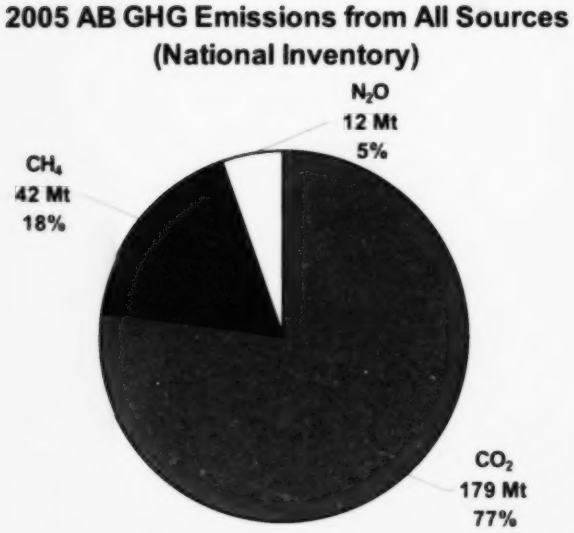

Figure 35: 2005 AB GHG Emissions from All Sources (National Inventory).

9.4 2005 Alberta greenhouse gas emissions by inventory source category

Using the categories from the *National Greenhouse Gas Inventory*, the largest source of greenhouse gas emissions for Alberta in 2005 was energy. The energy source category includes emissions from stationary fuel combustion sources (electricity and heat generation, fossil fuel industries, manufacturing, etc), transportation and fugitive sources. Greenhouse gas emissions from energy sources totaled 200 Mt or 86 per cent of 2005 total greenhouse gas emissions for the province. Figure 36 shows a breakdown of 2005 Alberta greenhouse gas emissions from all sources by inventory source category. Agricultural sources were the next largest source (eight per cent) of greenhouse gas emissions in the province with 18 Mt. Industrial process sources (chemical, cement, metal manufacturing, etc) were responsible for 12 Mt or five per cent of total 2005 Alberta greenhouse gas emissions. Waste sources contributed three Mt or one per cent of total 2005 Alberta greenhouse gas emissions. Solvent & other product use was the source of only 18 kt or less than one per cent of total 2005 Alberta greenhouse gas emissions. The solvent and other product use category is emissions resulting from the use of N_2O as an anesthetic and as a propellant.

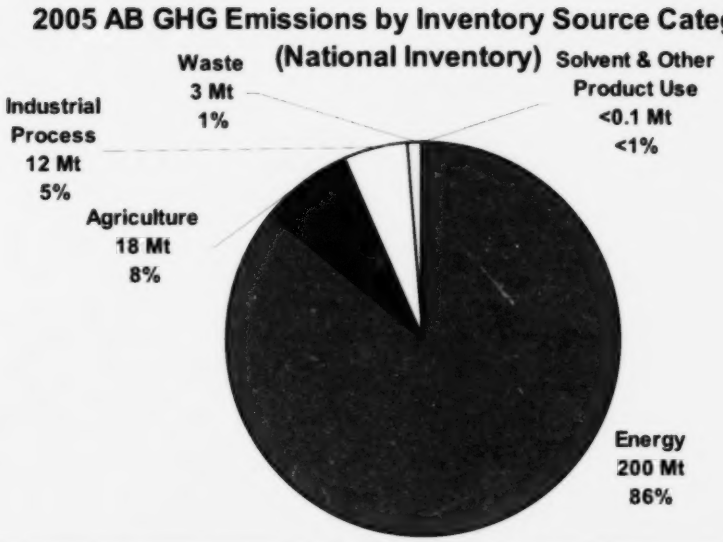

Figure 36: 2005 Alberta GHG Emissions by Inventory Source Category (National Inventory).

9.5 2005 Alberta largest greenhouse gas sources

The 233 Mt of Alberta greenhouse gases emissions accounted for by the *2005 National Greenhouse Gas Inventory* can be broken down into several major source categories (using categories established in the *National Inventory Report*). Figure 37 shows a breakdown of 2005 Alberta greenhouse gas emissions from all sources by major category. Of these emissions, 95 Mt or 41 per cent of total greenhouse gas emissions were from mining & oil & gas sources. This category includes fossil fuel industries, fugitive coal mining, fugitive oil and natural gas, mining & oil & gas extraction and pipeline sources. The second largest source of greenhouse gas emission in Alberta was from electricity and heat generation sources with 53 Mt or 23 per cent of total Alberta greenhouse gas emissions. Transportation (excluding pipelines) was the source of 31 Mt or 13 per cent of total Alberta greenhouse gas emissions. Agricultural sources were responsible for 18 Mt or eight per cent of total Alberta greenhouse gas emissions. Industrial process sources (chemical, cement, metal manufacturing, etc) contributed 12 Mt or five per cent of total Alberta greenhouse gas emissions. The remaining 23 Mt or 10 per cent of total Alberta greenhouse gas emissions were from sources that each accounted for less than five per cent of total greenhouse gas emissions. The "other" category in Figure 37 includes manufacturing industries, construction, commercial & institutional, residential, agriculture & forestry, solvent & other product use and waste sources.

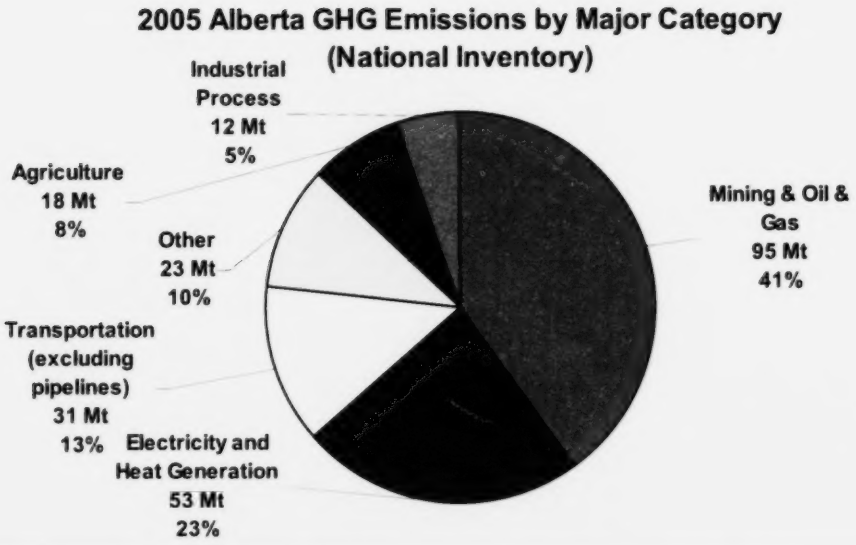

Figure 37: 2005 Alberta GHG Emissions by Major Category (National Inventory).

10.0 Alberta greenhouse gas trends (1990 – 2005)

The Government of Alberta has set a target of a 50 per cent reduction in greenhouse gas emissions intensity below 1990 levels by 2020. Greenhouse gas emissions intensity is a measure of the quantity of greenhouse gas emission versus the Alberta Gross Domestic Product (GDP). Alberta also has an interim target of a 30 per cent reduction in greenhouse gas emissions intensity by 2010. Figure 38 shows the trend in greenhouse gas emissions in Alberta since 1990. Total 2005 Alberta greenhouse gas emissions from all sources have risen by 37 per cent (63 Mt) since 1990. This compares to a 25 per cent increase for all of Canada and was the second largest percentage increase seen by any province, behind Saskatchewan.

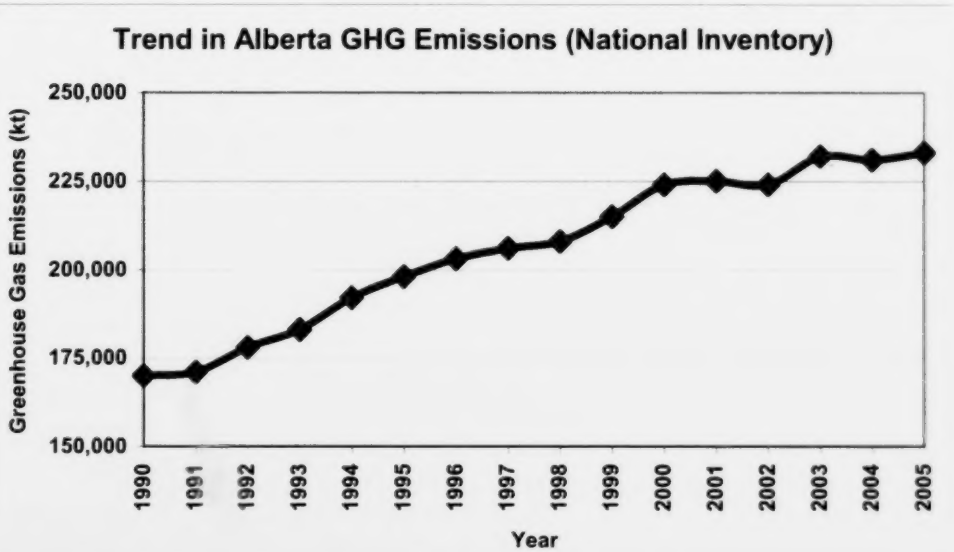

Figure 38: Trends in Alberta GHG Emissions (National Inventory).

Although Alberta's absolute greenhouse gas emissions have been increasing since 1990, the greenhouse gas emissions intensity for the province has been improving. As of 2005, Alberta's greenhouse gas emissions intensity has improved by more than 20 per cent. Figure 39 shows the trend in greenhouse gas emissions intensity in Alberta since 1990. In 1990, Alberta's greenhouse gas emissions were 170 Mt while Gross Domestic Product of the province totaled $82,227 million dollars (1997 dollars). The ratio of the greenhouse gas emissions per GDP gives an intensity value of 2.07. In 2005, Alberta's greenhouse gas emissions reached 233 Mt and GDP was $141,992 million dollars (1997 dollars). The ratio of greenhouse gas emissions per GDP was therefore an intensity value of 1.64. Alberta's greenhouse gas emissions have risen by 37 per cent since 1990, while during that same period of time Alberta's GDP has risen by nearly 73 per cent.

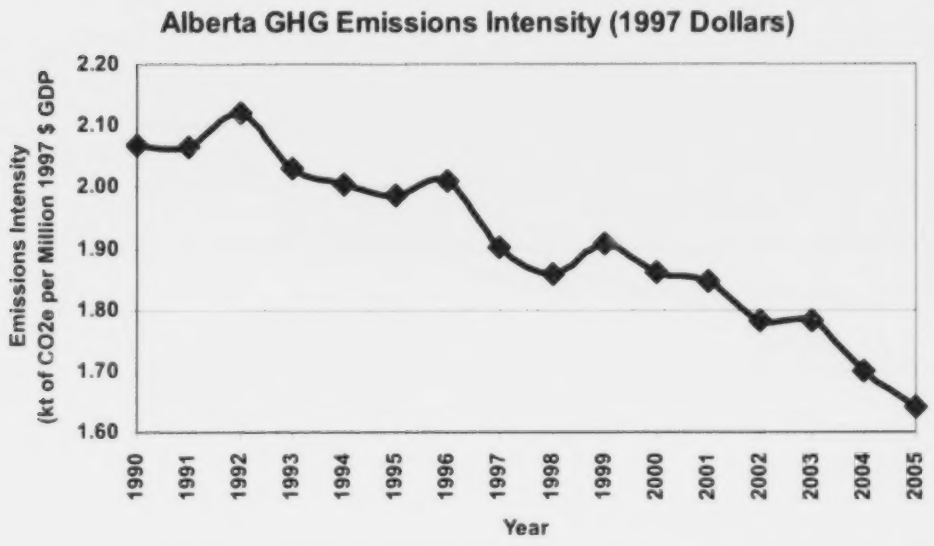

Figure 39: Alberta GHG Emissions Intensity (1997 Dollars).

Glossary of terms

Average absolute change: The average of the absolute value of all percentage changes in facility emissions between reporting years.

Average change: The average of all the percentage increases and decreases in facility emissions between reporting years.

Biomass: Plant materials, animal waste or any product made of either of these and includes without limitation wood and wood products, charcoal, agricultural residues and wastes including organic material above and below ground, both living and dead, such as trees, crops, grasses, tree litter, roots, municipal and industrial wastes where the organic material is biological in origin, landfill gas, bio-alcohols, black liquor, sludge gas, animal or plant-derived oils.

Carbon dioxide (CO_2): Carbon dioxide is a colourless, odourless gas found in the air. It is absorbed by plants and exhaled by animals. Carbon dioxide is also a greenhouse gas that traps infrared radiation in the atmosphere. The main human activity that produces carbon dioxide is the combustion of fossil fuels such as coal, oil, natural gas in power plants, vehicles and industrial facilities.

Carbon dioxide equivalent (CO_2e): Carbon dioxide equivalent is the concentration of CO_2 that would cause the same amount of absorption of infrared radiation in the atmosphere as another greenhouse gas. CO_2e is calculated by multiplying the emissions of a greenhouse gas by an established global warming potential to get an equivalent quantity of carbon dioxide. Using CO_2e permits the calculation of total greenhouse gas emissions for a particular source.

Climate change: Climate change is any change to the Earth's climate system that is attributed either directly or indirectly to human activities. These changes are due to alterations to the composition of the Earth's atmosphere. Climate change is beyond what is considered natural climate variability and occurs much faster than natural climate variability.

Direct emissions: The release of specified gases from sources actually located at a facility, expressed in tonnes on a CO_2e basis.

Electronic Data Reporting System (EDR): The Electronic Data Reporting System is a one-window secure web-based reporting tool for facilities to report greenhouse gas emissions to under the *Specified Gas Reporting Program* and the *National Mandatory Greenhouse Gas Reporting Program*.

Emission factor: An emission factor is a representative value that relates the rate or quantity of a gas released to the atmosphere with an activity associated with the release of that gas. Emission factors are used to calculate greenhouse gas emissions using mathematical calculations that use a set of parameters to provide reasonable estimations of the rate or quantity at which a pollutant is released to the atmosphere as a result of

some process or activity. The general emission equation is: greenhouse gas emissions = (emission factor X activity factor X control factor).

Emissions: Emissions are a quantity of a substance that is released to the air from a source.

Emissions intensity: Emissions intensity is a measure of a quantity of emissions against some associated unit of production. Emissions can be measured against Gross Domestic Product, barrels of oil, tonne of coal, megawatt hour of electricity, etc.

Engineering estimate: An engineering estimate is an emission estimation method based on engineering principles and judgement, using knowledge of the chemical and physical processes involved, the design features of the source, or an understanding of the applicable physical and chemical laws. Engineering estimates are usually developed by an engineer who is very familiar with a specific process or technology and use this knowledge to determine an approximate value for quantity of emissions. Engineering estimates are generally considered to be an approximate value for quantity of emissions.

Facility: Any plant, structure or thing where an activity listed in section 2 of the Schedule of Activities to the *Environmental Protection and Enhancement Act* occurs, and a site or one or more contiguous or adjacent sites that are operated and function in an integrated fashion where an activity listed in any of sections 3 to 11 of the Schedule of Activities to the *Environmental Protection and Enhancement Act* occurs, including all the buildings, equipment, structures, machinery and vehicles that are an integral part of the activity.

Flaring emissions: Flaring emissions are direct emissions from the controlled combustion of a gas or liquid stream produced on site not for the purpose of producing energy and includes without limitation emissions arising from waste petroleum incineration, hazardous emissions prevention systems (whether in pilot or active mode), well testing, natural gas gathering systems, processing plant operations, crude oil production, pipeline operations, petroleum refining and chemical fertilizer and steel production.

Geologically injected CO_2: Geological injected CO_2 is the quantity of CO_2 captured at a facility and injected into geological formations. Geologically injected CO_2 is not a direct emission.

Global warming potential (GWP): Global warming potential is the relative measure of the warming effect that the emission of a specified gas might have on the Earth's atmosphere calculated as the ratio of the time-integrated radiative forcing that would result from the emission of one kilogram of a given specified gas to that from the emission of one kilogram of carbon dioxide.

Greenhouse gases: Greenhouse gases are any gas that absorbs infrared radiation in the Earth's atmosphere. Greenhouse gases can come from both natural and human activities. Common greenhouse gases that result from human activities include carbon dioxide, methane and nitrous oxide.

Gross domestic product (GDP): Gross domestic product is the total value of goods and services produced by a jurisdiction, such as a province, territory or country.

Hydrofluorocarbons (HFC): Hydrofluorocarbons are synthetic industrial gases emitted in small quantities but are powerful greenhouse gases with global warming potentials of hundreds to thousands of times that of carbon dioxide. Hydrofluorocarbons include the following HFC Species: CHF_3, CH_2F_2, CH_3F, $C_5H_2F_{10}$ (structure: $CF_3CHFCHFCF_2CF_3$), C_2HF_5, $C_2H_2F_4$ (structure: CHF_2CHF_2), $C_2H_2F_4$ (structure: CH_2FCF_3), $C_2H_3F_3$ (structure: CHF_2CH_2F), $C_2H_3F_3$ (structure: CF_3CH_3), $C_2H_4F_2$ (structure: CH_3CHF_2), C_3HF_7 (structure: CF_3CHFCF_3), $C_3H_2F_6$ (structure: $CF_3CH_2CF_3$) and $C_3H_3F_5$ (structure: $CH_2FCF_2CHF_2$). Only HFC emissions from industrial process and industrial product use are reported under the *Specified Gas Reporting Program*. Sources of HFC emissions from industrial process and industrial product use include emissions from foam blowing and the use of HFC as a cover gas in metal production. HFC emissions from other applications such as refrigeration, air conditioning, aerosol propellants, fire extinguishers, some solvents, etc, are not considered industrial process or industrial product use and are not reported under the *Specified Gas Reporting Regulation*.

Industrial process emissions: Direct emissions from an industrial process involving chemical or physical reactions, other than combustion, and where the primary purpose of the industrial process is not energy production. This includes mineral, metal and chemical production. This source category is more sector-specific than stationary fuel combustion and is not found in all industrial sectors.

Industrial product use emissions: Direct emissions from the use of a product that does not react in the process and includes without limitation SF_6 and HFC use as a cover gas and use of SF_6 in electrical equipment.

Kilotonne: One thousand tonnes.

Mass balance: Mass balance is a type of emission estimation method whereby emissions are determined from the difference in the input and output of a unit operation where the accumulation and depletion of a substance are included in the calculations. Mass balance methods can be used to estimate the amount of greenhouse gas emissions released to the atmosphere based on the difference between amount of initial component contained in the materials that enter a process, the amount contained in the products and any wastes or residuals at the end of the process. This method calculates emissions using conservation laws.

Megatonne: One million tonnes.

Methane (CH_4): Methane is a colourless, odourless, flammable gas formed naturally by the decomposition of organic matter. Methane is also a greenhouse gas that traps infrared radiation in the atmosphere. Methane has a global warming potential 21 times that of carbon dioxide. Natural sources of methane include wetlands, permafrost, termites, water bodies and forest fires. Methane is also a hydrocarbon gas and is the principal constituent

of natural gas. Human activities that are sources of methane emissions include fossil fuel production, animal husbandry, rice cultivation, biomass burning, and waste management.

Monitoring or direct measurement: Monitoring or direct measurement is a type of emission estimation method using continuous emission monitoring systems (CEMS), predictive emission monitoring (correlations developed between measured emission rates and process parameters) or source testing such as stack sampling.

Nitrous oxide (N_2O): Nitrous oxide is a colourless, non-flammable gas with a sweet odour. Nitrous oxide is also a powerful greenhouse gas that traps infrared radiation in the atmosphere. Nitrous oxide has a global warming potential 310 times that of carbon dioxide. Nitrous oxide is produced naturally from a wide variety of biological sources in soil and water, particularly microbial action in wet tropical forests. Human activities that are sources of nitrous oxide include agricultural soil management, animal manure management, sewage treatment, mobile and stationary combustion of fossil fuel, and some chemical production.

On-site transportation: On-site transportation is a greenhouse gas source category with direct emissions resulting from fuel combustion in machinery used for the on-site transportation of products and material integral to the production process. Examples are the transportation of raw or intermediate products and materials within the production process; such as equipment used at an oil sands operation to mine and/or move materials to subsequent on-site processing, or equipment used at above or below ground mining operations to mine and/or move mined materials or other intermediate products or materials to different on-site production processes.

Other fugitive: Other fugitive emissions are direct emissions that do not fall under stationary fuel combustion emissions, industrial process emissions, venting emissions, flaring emissions, on-site transportation emissions, or waste and wastewater emissions and includes without limitation intentional or unintentional releases of gases arising from the production, processing, transmission, storage and use of solid, liquid or gaseous fuels. In general, emissions from other fugitive sources are a result of the handling or processing of various types of fuel in the fossil fuel industry. Other fugitive sources include leaks from natural gas transmission lines and processing plants, accidental releases from oil and gas wells and releases from the mining and handling of coal.

Perfluorocarbons (PFC): Perfluorocarbons are synthetic industrial gases emitted in small quantities but are powerful greenhouse gases with global warming potential of hundreds to thousands of times that of carbon dioxide. Perfluorocarbons include the following PFC species: CF_4, C_2F_6, C_3F_8, C_4F_{10}, c-C_4F_8, C_5F_{12}, and C_6F_{14}. Only PFC emissions from industrial process and industrial product use are reported under the *Specified Gas Reporting Program*. Sources of PFC emissions from industrial process and industrial product use include aluminum production and foam blowing. PFC emissions from other applications such as refrigeration, air conditioning, semiconductor manufacturing, aerosol propellants, fire extinguishers, some solvents, etc are not considered industrial process or industrial product use and are not reported under the *Regulation*.

Regulation: The *Specified Gas Reporting Regulation*.

Specified gas: Specified gases are those identified in the *Specified Gas Reporting Regulation*. This includes: carbon dioxide, methane, nitrous oxide, species of hydrofluorocarbons, species of perfluorocarbons and sulphur hexafluoride.

Stationary fuel combustion: Stationary fuel combustion emissions are direct emissions resulting from non-vehicular combustion of fossil or biomass fuel for the purpose of producing energy but do not include biomass combustion CO_2 emissions. Stationary fuel combustion is a common source of greenhouse gas emissions and is produced in most industrial sectors. The stationary fuel combustion source category includes on-site waste incineration if the waste is combusted for the purpose of energy production.

Sulphur hexafluoride (SF_6): Sulphur hexafluoride is a synthetic industrial gas that is emitted in small quantities but is a powerful greenhouse gas with a global warming potential thousands of times that of carbon dioxide. Only SF_6 emissions from industrial process and industrial product use are reported under the *Specified Gas Reporting Program*. Sources of SF_6 from industrial process and industrial product use are uses such as a cover gas in magnesium smelting and casting, as foundry products in the aluminum industry, or as an insulting gas in electrical equipment such as circuit breakers. SF_6 emissions from other applications such as fire suppression, explosion protection, leak detection and electronic applications are not considered industrial process or industrial product use and are not reported under the *Regulation*.

Venting emissions: Venting emissions are direct emissions from intentional releases to the atmosphere of a waste gas or liquid stream and includes without limitation emissions of casing gas, associated (or solution) gas, treater, stabilizer, dehydrator off-gas, blanket gas and emissions from pneumatic devices which use natural gas as a driver, compressor start-up, pipeline and other blowdowns and metering and regulation station control loops;

Voluntary reporter: A voluntary reporter is a facility that reports greenhouse gas emissions to Alberta Environment even though it did not exceed the 100 kt reporting threshold and thus is not required to do so under the *Regulation*.

Waste and wastewater: Waste and wastewater emissions are direct emissions from disposal of waste and waste or wastewater treatment and includes without limitation sources of emissions from on-site waste disposal and waste or wastewater treatment at a facility such as landfilling of solid waste, flaring of landfill gas, treatment of liquid waste and waste incineration.

Appendix

Table 8: 2006 Reported Alberta Greenhouse Gas Emissions by Facility Type.

Facility Type	Reporting Company	Facility Name	CO_2 (tonnes)	CH_4 (tonnes)	N_2O (tonnes)	HFC (tonnes)	Total GHG (tonnes)
Cement	Lafarge Canada Inc	Exshaw Cement Plant	1,223,588.0	2.8	25.0		1,223,615.8
Cement	Lehigh Inland Cement Limited	Lehigh Inland Cement	930,158.0				930,158.0
Chemical	Alberta Envirofuels Inc.	Alberta Envirofuels Inc.	336,836.0	1,176.0	2,139.0		340,151.0
Chemical	Cancarb Ltd.	Cancarb Ltd.	125,507.0	0.4	2,154.5		127,661.9
Chemical	Celanese Canada Inc.	Edmonton Facility	532,792.0	405.8	1,940.0		535,137.8
Chemical	Air Products Canada Ltd	Edmonton Hydrogen Facility	275,075.5		1,447.9		276,523.4
Chemical	MEGlobal Canada Inc.	FS1 EOEG	101,654.8	1,302.8			102,957.6
Chemical	INEOS Canada Partnership	Joffre LAO Plant	129,733.2	50.7	682.4		130,466.3
Chemical	NOVA Chemicals Corporation	NOVA Chemicals Corporation (Joffre)	2,743,524.5	1,659.8	13,251.6		2,758,435.8
Chemical	MEGlobal Canada Inc.	Prentiss Manufacturing Facility	296,558.1	1,482.8	256.0		298,296.9
Chemical	Dow Chemical Canada Inc.	Prentiss Manufacturing Facility	32,545.9	994.6	14.6		33,555.1
Chemical	Shell Chemicals Canada Ltd	Scotford Chemical Plant	292,096.0	38.3	1,085.9	2,263.8	295,484.0
Chemical	Air Liquide Canada Inc.	Scotford Complex	383,072.9	157.5	1,976.9		385,207.3
Chemical	Dow Chemical Canada Inc.	Western Canada Operations	1,539,138.9	1,523.6	2,572.1	3,120.0	1,546,354.5
Coal-Mining	Coal Valley Resources Inc.	Coal Valley Mine	115,256.0	80.2	840.1		116,176.3
Coal-Mining	TransAlta Utilities Corporation	Highvale Coal Mine	74,324.8	118,820.3	732.8		193,878.0
Fertilizer	Agrium Inc.	Agrium Redwater Fertilizer Operation	1,096,204.9	8,630.6	13,333.1		1,118,168.5
Fertilizer	Canadian Fertilizers Limited	Canadian Fertilizers Limited	1,653,542.0	348.8	4,925.9		1,658,816.7
Fertilizer	Agrium Inc	Carseland Nitrogen Operations	542,197.0	7,711.1	1,991.4		551,899.6
Fertilizer	Orica Canada Inc	Carseland Works	480.0		729,430.0		729,910.0

Facility Type	Reporting Company	Facility Name	CO_2 (tonnes)	CH_4 (tonnes)	N_2O (tonnes)	HFC (tonnes)	Total GHG (tonnes)
Fertilizer	Agrium Inc.	Fort Saskatchewan Nitrogen Operation	505,052.6	1,089.9	1,577.9		507,720.4
Forest Products	Alberta-Pacific Forest Industries Inc.	Alberta-Pacific Forest Industries Inc. Pulp Mill	78,653.1	1,911.1	19,408.4		99,972.7
Forest Products	Weyerhaeuser Company Limited	Grande Prairie Operations	72,057.4	24,576.5	9,526.3		106,160.2
Forest Products	West Fraser Mills Ltd.	Hinton Pulp	127,281.7	10,679.8	11,550.3		149,511.8
Forest Products	Daishowa-Marubeni International Ltd-Peace River	Peace River Pulp Division	66,970.1	11,410.0	10,161.5		88,541.5
Gas Plant	Nexen Inc.	Balzac Gas Processing Plant	211,023.0	28,853.2	1,853.8		241,730.0
Gas Plant	Imperial Oil Resources	Bonnie Glen Gas Plant	313,385.9	28,035.0	4,216.0		345,636.9
Gas Plant	Petro-Canada Oil & Gas	Brazeau Gas Plant	128,476.5	11,609.0	6,045.6		146,131.1
Gas Plant	Keyera Energy	Brazeau GP	88,753.9	6,222.9	3,844.0		98,820.8
Gas Plant	EnCana Corporation	Caribou North Compressor Station	79,161.4	21,505.5	527.0		101,193.9
Gas Plant	Bonavista Petroleum Ltd.	Carstairs - Crossfield Gas Plant	98,523.3	2,584.5	595.2		101,702.9
Gas Plant	Inter Pipeline Extraction Ltd.	Cochrane Extraction Plant	323,772.8	6,147.8	3,236.7		333,157.3
Gas Plant	PrimeWest Energy Inc.	East Crossfield Gas Plant 9-14-28-01W4	156,142.8	5,585.8	1,536.4		163,265.0
Gas Plant	Talisman Energy Inc.	Edson Gas Plant	224,404.2	11,002.3	3,592.9		238,999.4
Gas Plant	ConocoPhillips Canada	Elmworth Gas Plant	176,159.8	10,657.7	3,273.6		190,091.1
Gas Plant	Duke Energy Empress LP	Empress straddle plant system	367,230.4	3,448.2	2,325.0		373,003.6
Gas Plant	Petro-Canada Oil & Gas	Hanlan Robb Gas Plant	582,352.1	23,219.4	17,100.5		622,672.0
Gas Plant	Taylor Processing Inc.	Harmattan Gas Processing Plant	237,329.3	14,611.2	1,103.6		253,044.1

Facility Type	Reporting Company	Facility Name	CO_2 (tonnes)	CH_4 (tonnes)	N_2O (tonnes)	HFC (tonnes)	Total GHG (tonnes)
Gas Plant	Canadian Natural Resources Limited	Hays Gas Plant	38,572.4	12,807.9	4,681.0		56,061.3
Gas Plant	Pengrowth Corporation	Judy Creek Gas Conservation Plant (JCGCP)	124,342.4	24,537.9	6,308.5		155,188.8
Gas Plant	Pengrowth Corporation	Judy Creek Production Complex	78,077.0	11,677.3	5,790.8		95,545.2
Gas Plant	SemCams	K3 1-15 GP	373,716.3	6,671.5	1,674.0		382,061.8
Gas Plant	SemCams	KA 1-12 GP	198,246.7	11,400.7	2,879.9		212,527.2
Gas Plant	Canadian Natural Resources Limited	Karr Gas Plant/Gathering System	66,779.3	40,831.6	4,495.0		112,105.9
Gas Plant	BP Canada Energy Company	Marten Hills Gas Plant	62,431.7	22,565.0	6,732.5		91,729.2
Gas Plant	Duke Energy Field Services Canada	Nevis Gas Plant	104,582.9	6,913.2	269.7		111,765.8
Gas Plant	Pengrowth Corporation	Olds Gas Plant	137,559.7	2,725.3	2,049.1		142,334.1
Gas Plant	Imperial Oil Resources	Quirk Creek Gas Plant	131,342.2	10,577.7	951.7		142,871.6
Gas Plant	Husky Energy	ram River	864,765.0	6,127.8	2,173.1		873,065.9
Gas Plant	Keyera Energy	Rimbey Gas Plant	255,670.0	7,698.2	3,543.3		266,911.5
Gas Plant	Shell Canada Limited	Shell Burnt Timber Gas Plant	185,245.0	45,360.0	930.0		231,535.0
Gas Plant	Shell Canada Limited	Shell Caroline Complex	558,082.0	71,253.0	4,030.0		633,365.0
Gas Plant	Shell Canada Limited	Shell Jumping Pound Gas Plant	251,177.0	77,595.0	2,170.0		330,942.0
Gas Plant	Keyera Energy	Strachan GP	238,087.7	5,284.7	2,303.3		245,675.6
Gas Plant	Devon Canada Corporation	Wapiti Gas Plant	122,993.5	11,806.8	1,407.4		136,207.8
Gas Plant	Shell Canada Limited	Waterton Complex	509,518.0	85,617.0	5,890.0		601,025.0
Gas Plant	Petro-Canada Oil & Gas	Wildcat Hills Gas Plant	160,128.1	6,942.9	4,414.4		171,485.4
Gas Plant	SemCams	Windfall 8-17 GP	161,303.5	12,105.0	3,468.9		176,877.4
Gas Plant	Apache Canada Ltd.	Zama Gas Plant: 1, 2, 3	96,608.8	29,738.9	1,823.7		128,171.4

Facility Type	Reporting Company	Facility Name	CO_2 (tonnes)	CH_4 (tonnes)	N_2O (tonnes)	HFC (tonnes)	Total GHG (tonnes)
Heavy Oil	FCCL Oil Sands Partnership	Christina Lake SAGD Bitumen Battery	112,940.0	375.7	179.8		113,495.5
Heavy Oil	Imperial Oil Resources	Cold Lake	4,594,333.7	11,413.5	13,919.0		4,619,666.2
Heavy Oil	FCCL Oil Sands Partnership	Foster Creek SAGD Bitumen Battery	416,487.0	485.3	722.3		417,694.7
Heavy Oil	Japan Canada Oil Sands Limited	Hangingstone SAGD Demonstration Facility	237,708.0	1,157.0	596.2		239,461.2
Heavy Oil	Shell Canada Limited	Peace River Complex	327,985.0	38,493.0	5,580.0		372,058.0
Heavy Oil	Canadian Natural Resources Limited	Wolf Lake/Primrose Thermal Operation	2,357,228.0	101,142.9	16,247.1		2,474,618.0
Landfill	City of Calgary	East Calgary Landfill		145,672.8			145,672.8
Lime	Graymont Western Canada Inc.	Exshaw	173,460.7	21.6	226.3		173,708.6
Metal Manufacturing	Sherritt International Corporation	Fort Saskatchewan	272,084.0	85.7	1,141.4		273,311.1
Oil Sands	Petro-Canada	MacKay River, In-Situ Oil Sands Plant	128,105.5	35,527.5	680.1		164,313.1
Oil Sands	Syncrude Canada Ltd.	Mildred Lake and Aurora North Plant Sites	11,701,827.3	802,285.3	116,099.0		12,620,211.7
Oil Sands	Albian Sands Energy Inc.	Muskeg River Mine	254,039.1	17,502.5	1,969.1		273,510.7
Oil Sands	Shell Canada Limited	Scotford Upgrader and Upgrader Cogeneration	1,764,366.0	378.0	10,540.0		1,775,284.0
Oil Sands	Suncor Energy Inc. Oil Sands	Suncor Energy Inc. Oil Sands	8,641,227.1	397,867.2	92,945.7		9,132,040.0
Petroleum Refining	Petro-Canada	Edmonton Refinery	1,818,009.1	66,896.3	117,341.2		2,002,246.7
Petroleum Refining	Shell Canada Products	Shell Scotford Refinery	1,102,962.0	273.0	2,790.0		1,106,025.0
Petroleum Refining	Imperial Oil Limited	Strathcona Refinery	1,366,597.0	511.4	8,450.9		1,375,559.3
Pipeline	Alliance Pipeline Ltd.	Alberta Pipeline System	536,373.7	55,908.3	3,866.0		596,148.0

Facility Type	Reporting Company	Facility Name	CO_2 (tonnes)	CH_4 (tonnes)	N_2O (tonnes)	HFC (tonnes)	Total GHG (tonnes)
Pipeline	ATCO Gas and Pipelines Ltd	ATCO Gas - Distribution Systems and Carbon Plant	25,699.6	223,472.8	1,492.7		250,665.0
Pipeline	**ATCO Gas and Pipelines Ltd.**	**ATCO Pipelines**	**71,283.4**	**121,978.3**	**1,187.7**		**194,449.4**
Pipeline	Foothills Pipe Lines Ltd.	Foothills Pipeline System, Alberta	268,425.9	6,801.0	3,654.9		278,881.8
Pipeline	**Nova Gas Transmission Ltd.**	**TransCanada Pipeline System, Alberta**	**1,998,093.8**	**301,330.9**	**32,469.4**		**2,331,894.1**
Power Plant	Nexen Inc.	Balzac Power Station	105,155.0	827.6	802.9		106,785.5
Power Plant	**Alberta Power (2000) Ltd.**	**Battle River Generating Station**	**5,483,959.4**	**1,439.2**	**30,716.4**		**5,516,115.1**
Power Plant	Calgary Energy Centre	Calgary energy Center	362,716.9	555.1	2,890.4		366,162.4
Power Plant	**TransCanada Energy Ltd.**	**Carseland Power Plant, Alberta**	**328,512.9**	**1,020.9**	**4,116.2**		**333,650.0**
Power Plant	EnCana Corporation	Cavalier Power Plant	184,898.7	342.3	1,416.7		186,657.7
Power Plant	**City Of Medicine Hat**	**City Of Medicine Hat, Electric Utility - Generation**	**270,001.8**	**441.0**	**2,263.0**		**272,705.8**
Power Plant	TransAlta Cogeneration LP	Fort Saskatchewan Generating Plant	242,386.6	405.2	2,026.5		244,818.3
Power Plant	**FCCL Oil Sands Partnership**	**Foster Creek Cogeneration Facility**	**503,304.0**	**655.2**	**5,700.9**		**509,660.1**
Power Plant	EPCOR Power Generation Services Inc.	Genesee Thermal Generating Station	9,660,926.6	1,640.9	80,744.2		9,743,311.6
Power Plant	**Milner Power Limited Partnership by its GP Milner Power Inc.**	**H.R. Milner Generating Station**	**943,206.7**	**278.1**	**5,202.0**		**948,686.8**
Power Plant	TransAlta Utilities Corporation	Keephills Generating Plant	6,234,651.8	1,451.6	42,767.9		6,278,871.3

Facility Type	Reporting Company	Facility Name	CO_2 (tonnes)	CH_4 (tonnes)	N_2O (tonnes)	HFC (tonnes)	Total GHG (tonnes)
Power Plant	TransCanada Energy Ltd.	Mackay River Power Plant, Alberta	719,246.6	1,197.1	9,410.4		729,854.1
Power Plant	ATCO Power Canada Ltd.	Muskeg River Cogeneration Power Plant	1,190,471.6	1,333.4	6,656.4		1,198,461.4
Power Plant	ATCO Power Alberta Ltd.	Poplar Hill Generating Station	17,795.7	29.2	150.4		17,975.4
Power Plant	ATCO Power Alberta Ltd.	Rainbow Lake Cogeneration Power Plant (Units 4-5)	259,531.6	426.1	2,194.2		262,151.9
Power Plant	Alberta Power (2000) Ltd.	Rainbow Lake Generating Station (Units 1-3)	36,731.0	60.3	310.6		37,101.8
Power Plant	TransCanada Energy Ltd.	Redwater Cogeneration Facility, Alberta	178,443.9	8,354.1	2,064.9		188,862.9
Power Plant	Alberta Power (2000) Ltd.	Sheerness Generating Station	6,409,043.5	1,687.2	35,997.5		6,446,728.2
Power Plant	Alberta Power (2000) Ltd.	Sturgeon Generating Station (Units 1& 2)	1,424.8	2.3	12.1		1,439.2
Power Plant	TransAlta Utilities Corporation	Sundance Generating Plant	15,903,518.5	3,810.2	111,937.3		16,019,266.0
Power Plant	ATCO Power Alberta Ltd.	Valleyview Generating Station	4,506.4	7.4	38.1		4,551.9
Power Plant	TransAlta Utilities Corporation	Wabamun Generating Plant	2,247,045.5	576.0	17,005.7		2,264,627.2

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